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THE TEACHING OF ASTRONOMY.
(Third Paper)

By WILLIAM F. MEYER.

In responding to the invitation of the editor to write an article on the teaching of astronomy, it is evident that such an article, if it is the result of experience, must be somewhat personal in its content. It is my purpose to set forth, from observation and twenty years experience, what seems to me the most productive method in the teaching of astronomy. In the preceding articles on this topic the writers have shown the place and value of astronomy in education. To their conclusions I heartily agree.

In all probability there are no two institutions where the astronomical equipment, the number of students enrolled in astronomy, and the preparation of the students are the same. In many colleges astronomy is offered only to students who have had freshman mathematics and physics, while in some of our larger universities elementary astronomy (Astronomy 1) is open to freshmen who have merely had high school algebra and geometry. In some institutions astronomy is not accepted to meet science requirements, while in others it is.

The selection of topics to be taught, the order and method of presentation, should depend upon the purpose in mind. If the course is elective and is offered largely for its cultural value the presentation of the subject matter may profitably be in the nature of descriptive astronomy with a liberal use of lantern slides. It is my opinion that there is room for such a course in all of our larger institutions for the benefit of those who are planning to be teachers in elementary and secondary schools. Such a course in astronomy should be free from the mathematical problems and presented from the historical view point in order to bring out the evolutionary conceptions of the universe. Frequent reference should be made to the place of astronomy in literature. If such a course were offered in our normal schools and teachers' colleges, the ignorance displayed by some of the promising young teachers would largely be remedied. While in residence at the Lick Observatory in 1926, I had occasion to be on duty when the senior class from one of our teachers' colleges was making a visit to the Observatory. One of the most interesting astronomical sights from the observatory is the setting sun. While the group was observing the distorted disk of the sun, some one asked for the cause of the phenomenon. Before answering the question,

I asked if anyone in the group would volunteer an answer. Not one out of the hundred or more responded to the request. Dr. Aitken tells the story of a teacher who visited the Observatory one evening when the planet Jupiter was being shown in the 36-inch telescope. After a glance at the disk of the planet, she exclaimed, "Is this a star? I thought all stars had five points"!

In the University of California, elementary astronomy is offered and largely taken by freshmen to fulfill science requirements for junior standing. Elementary algebra and plane geometry are prerequisites for the course. The student may choose between two courses. One is purely a lecture course, while the other combines lectures with one regular observing period each week. The observing class meets from seven to ten o'clock in the evening. My experince is largely with this second course and I wish to emphasize the value of a regular observing period in conjunction with the teaching of the subject matter. If astronomy is to take its place in the university as a science on a par with physics and chemistry, it is not sufficient that the student merely learn the astronomical facts about the sun, moon, planets, and stars, but the more important thing is to learn the fundamental principles by which these facts are obtained. It is in such a course of astronomy that the alert student is discovered while the student who is looking for a "snap" course in science drops out to seek some course where a little memory and no reasoning power is required.

My experience with this course has convinced me that it is not necessary to postpone the topic of coördinate systems until the student has been introduced to a more interesting topic like the earth or moon. Since astronomy is a science of observation, the first natural topic is, how to locate or designate the position of a heavenly body and here the observing period plays an important rôle. The first observing problem assigned to the student is to identify, with the aid of a simple star chart, the brightest stars visible and to estimate the azimuth and altitude of those stars. Not only is the student introduced to the stars, but he has his first experience in using his arms as pointers and his eyes to estimate angular distances on the celestial sphere. In the second or third week he is ready to prove, with the aid of the hour circles on a small telescope, that the right ascension of a star plus its hour angle is equal to the sidereal time (as shown by a chronometer) and through this relation to learn how a telescope can be pointed to an object not visible to the naked eye. With these experiences the student gets a real "thrill" from a study of the coördinate systems. Instead of committing to memory some meaningless definitions he has learned the real value and importance of the fundamental starting data in astronomy. What a joy is his when a little later in the course he has his first experience in locating a nebula or star cluster by means of the coördinates and circles on the telescope.

The story is the same when it comes to the other practical problems.

The relation that the elevation of the pole equals the latitude of the observer becomes very real to the student when he determines the latitude of the observatory by an altitude of Polaris with the surveyor's transit. Who does not recall with pleasure his first experience in watching a star cross the meridian in an astronomical transit instrument and with what pride he called "time" the instant the star was on the middle wire, while another student read the chronometer?

No study of the moon is complete until the student has had an opportunity to draw the surface features as he sees them in a small telescope. The same is true of the brighter planets. To plot the position of one or more sunspots on successive or alternate days is the best visible proof, to the student, that the sun rotates. And so we could go on indefinitely in illustrating the value of regular observational work in conjunction with the teaching of the subject matter. It almost seems superflous to emphasize the necessity of using models of the celestial sphere and solar system in connection with the classroom work. In addition to these, the Foucault pendulum experiment, the little piece of apparatus to illustrate effects of the earth's rotation, a gyroscope to illustrate precession and nutation, are indispensable in presenting topics pertaining to the earth.

At the end of the regular course in astronomy I frequently ask the students to give in writing a frank estimate of the benefits derived from their study. In concluding this article, I can do no better than to quote a few statements from a student's opinion. "Educational benefits: Precision of thought and of expression. Carefulness and accuracy in scientific observations. The incentive given for research in astronomy and other scientific fields.

"Cultural benefits: The acquisition of a first hand knowledge of the oldest of the sciences. The ability to better understand and appreciate the many references to the wonders of the starry firmament which occur in literature both ancient and modern. The ability to interpret the many legends of the stars found in all languages as manifestations of the growth of culture, development of intelligence, the evolution of religious thought.

"Philosophical benefits: Gives an extended view of the problems of philosophy. Magnifies one's conception of the vastness of the universe. Amplifies the significance of Nature's laws and of the Divine source of these laws."

STUDENTS' OBSERVATORY, UNIVERSITY OF CALIFORNIA,
DECEMBER 8, 1927.

SPECTRUM OF COMET 1927 *c*
(Pons-Winnecke Periodic)

By N. T. BOBROVNIKOFF and A. POGO.

Seven spectrograms of this comet were obtained at the Yerkes Observatory during the period from June 19 to June 28, 1927, at its closest approach to the earth. Eastman Speedway plates were used and the time of exposure ranged from 30 minutes to 2 hours 45 minutes. The instrument used was the Zeiss UV camera (aperture 14.5 cm, focus 81.4 cm) in conjunction with the 30° prism of ultra-violet glass. This arrangement gave a scale of 6.3 mm between Hβ (λ4861) and Hθ (λ3798).

In view of the diffuse character of the cometary head, only approximate measurements could be made. Indeed, on most plates the knots representing monochromatic images of the comet's head were so diffuse under the microscope that the setting of the thread was barely possible. Plate OP 831, June 28, from $5^h\,55^m$ to $7^h\,30^m$ U.T., gave the wave-lengths $\lambda\lambda$4020-4100 and 4630-4740 for the edges of the knots. The wave-length of the edge of the knot in the violet was taken as λ3883 (Cyanogen, CN IV) and by means of a reduction curve based on the Balmer lines in the spectrum of the comparison star Altair obtained near the comet on the same plate, the wave-lengths of the two other knots were derived.

Figure 1 represents an enlargement from the plate OP 831. The spectrum of the comet is given at the top. Below it runs its intensity curve obtained by means of a self-registering thermopile-microphotometer (Bi and Ag Coblentz thermopile, Leeds and Northrup galvanometer). On the original microphotometer record the distance between Hβ and Hθ was 10 cm. Below this cometary intensity curve is given the spectrum of Altair and its microphotometer tracing. The spectral images were enlarged and the microphotometer records reduced so as to give the same scale; corresponding wave-lengths were aligned vertically. The parallel lines on both microphotometer tracings represent: the lower, "clear film," or deviation of the galvanometer at a spot just outside the spectrum; the upper, "darkness," corresponds to the deflection of the galvanometer with no light falling on the thermopile.

The three prominent knots in the cometary spectrum have been identified as the Cyanogen IV Group (λ3883, CN IV), C + H (λ4020-4100) and the Swan IV Group (λ4630-4740, C IV). The condensation belonging to C + H is the brightest and the largest, which constitutes the peculiar feature of this comet. Another notable fact is the presence of a strong continuous spectrum with the maximum of intensity in the

neighborhood of λ4000. It cannot be ascribed to the reflected solar light in the usual sense of the word, since the solar spectrum has, under the same instrumental conditions, its maximum of intensity at λ4700.

The ultra-violet spectrum of the comet was considerably developed, although no bright emissions could be identified in that region. Comparison with the spectrum of Altair shows that the cometary spectrum extended practically as far in the ultra-violet as the spectrum of Altair from the limit of the Balmer series. The edge of the C IV band is clearly not its brightest part and a considerable shift of intensity in this band toward the violet can be noticed.

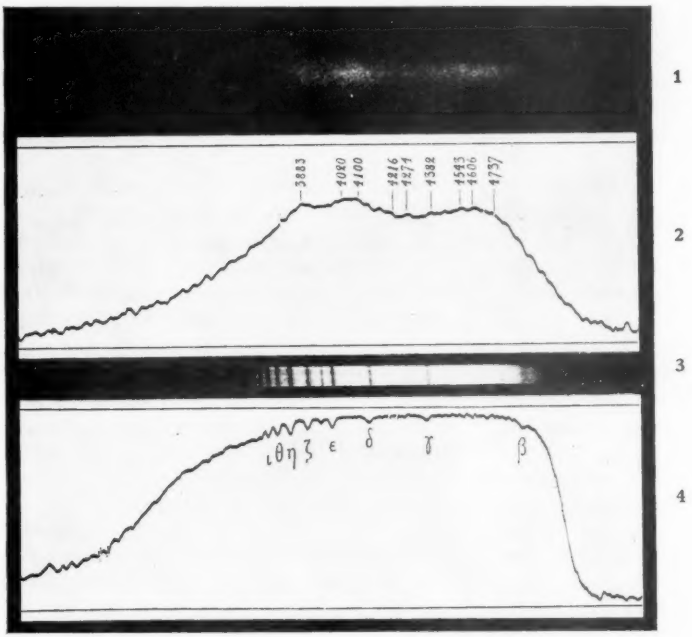


FIGURE 1.

1. Spectrum of comet Pons-Winnecke.
2. Intensity curve of the comet's spectrum.
3. Spectrum of Altair.
4. Intensity curve of the spectrum of Altair.

In many respects the spectrum of the Pons-Winnecke comet curiously resembles that of Temple$_2$ (1925 *d*). Both comets had a strong continuous spectrum with the maximum of intensity in the violet and relatively faint superimposed bands.

The wave-lengths of λ4216 (CN III), λ4382 (CV), and λ4605 (CN II) were found, on the thermopile record, by means of the scale

derived from the Balmer lines. They correspond only to slight elevations in the intensity curve, which means that these radiations were so faint as to be almost completely obliterated by the bright continuous background. Two more slight raisings of the curves at λ4274 and λ4543 may correspond to the faint radiations of CO^+ (Comet Tail Bands or Third Negative Carbon Group). In this case two other bands of this group would be masked by far more intense C + H and Swan knots.

On several plates the CN IV and C + H heads have noticeable fan-shaped emissions whose axes are parallel. On plate OP 831 the position angle of the axis of the fan is about 37°. The direct photograph obtained almost simultaneously by Professor G. Van Biesbroeck with the 24-inch reflector shows a fan identical in shape and in position angle. Such fans are frequent cometary phenomena.

Further comparison of the direct photograph with the spectral images indicates that the continuous spectrum was produced not only by the nucleus proper of the comet, but also by the bright nebulosity with rather sharp edges extending on one side from the nucleus. Next in size come the heads C IV and CN IV and the largest C + H head. The last corresponds to the bright inner part of the comet. The diameters of the different knots on the spectral plate perpendicular to the line of the continuous spectrum were measured, on the linear scale, as follows: C + H, 5000 km; CN IV, 3600 km; C IV, 3000 km; continuous spectrum, 2000 km. The diffuseness of the images involves considerable uncertainty and permits only a rough approximation.

Other plates give practically the same intensity curves and the same results, so that the plate OP 831, described above, may be considered as a typical spectrogram of the comet at the time of its approach to the earth. However, plate OP 824, June 10, exposure 10 min., taken through clouds, shows a faint spectrum in which the CN IV band is brighter than C + H. On plate OP 825, June 19, exposure 40 min., the reverse is true and since that time it remains so at different exposures. This eliminates the possibility of photographic effects. If we can rely on these two observations, the change must have occurred between June 10 and June 19.

The spectrum of this comet was observed visually in 1869 by C. Wolf.* He found the three usual bands, apparently belonging to the Swan spectrum.

Yerkes Observatory, August, 1927.

Comptes Rendus, **68**, 1470, 1869.

NOTE ON THE ORIGIN OF THE NEBULAR SPECTRUM.

By C. T. ELVEY.

In a recent number of the *Publications of the Astronomical Society of the Pacific,* Bowen[1] has suggested a hypothesis to account for the origin of the nebular spectrum. The arguments used are as follows: The investigations of the nebular spectra have indicated that the lines originate in atoms of light weight. As none of the light weight elements show a spectrum similar to that of the nebulae, and as modern physical theory shows that there is no place left in the periodic table for an unknown element of small atomic weight, it seems probable that the nebular lines originate from some known atom but that it takes some physical property, existing in the nebulae and which cannot be produced in the laboratory, to excite them. The most probable thing is the extremely low densities, of the order of millionths of the density in the best vacuums obtainable in the laboratory.

The production of a line spectrum is the result of the return of an electron from a state of higher energy to one of lower energy in the atom, the transfer occurring spontaneously after the electron has been in the orbit of higher energy for about a hundred millionths of a second. There are other states, however, into which an electron may get and not return spontaneously. These are called metastable states and the return to normal, or to some other state, is accomplished by a collision with another atom. In the most rarefied vacuum obtainable in the laboratory the impacts, or collisions of the second kind, occur in intervals of less than a thousandth of a second. Bowen's suggestion is that given enough time the excited atoms in the metastable states will return to states of lower energy spontaneously. This means that there must be very few atoms per cubic centimeter in order that the interval between collisions will be long. The best available evidence is that the densities existing in the nebulae are very small, and the interval between impacts is estimated at from ten thousand to a million seconds.

The laboratory investigations of the spectra of elements give the energy states of the atoms and from Bohr's theory the wave-length of the emitted light may be computed. Bowen has calculated the wavelengths that would be obtained by transitions from metastable states of some of the light weight atoms and finds that the chief nebular lines may be represented by radiation from singly-ionized nitrogen and singly- and doubly-ionized oxygen. The two nebular lines in the green and the one near Hγ line of hydrogen are due to doubly-ionized oxygen.

A. Fowler[2] with the use of more data than were available to Bowen

[1] I. S. Bowen, *A.S.P.*, **39**, 295, (1927).
[2] *Nature*, **120**, 617, (1927 Oct. 29).

has since made the calculations and confirms the suggestion of Bowen, saying "—leaves little doubt that Bowen's interpretation is correct."

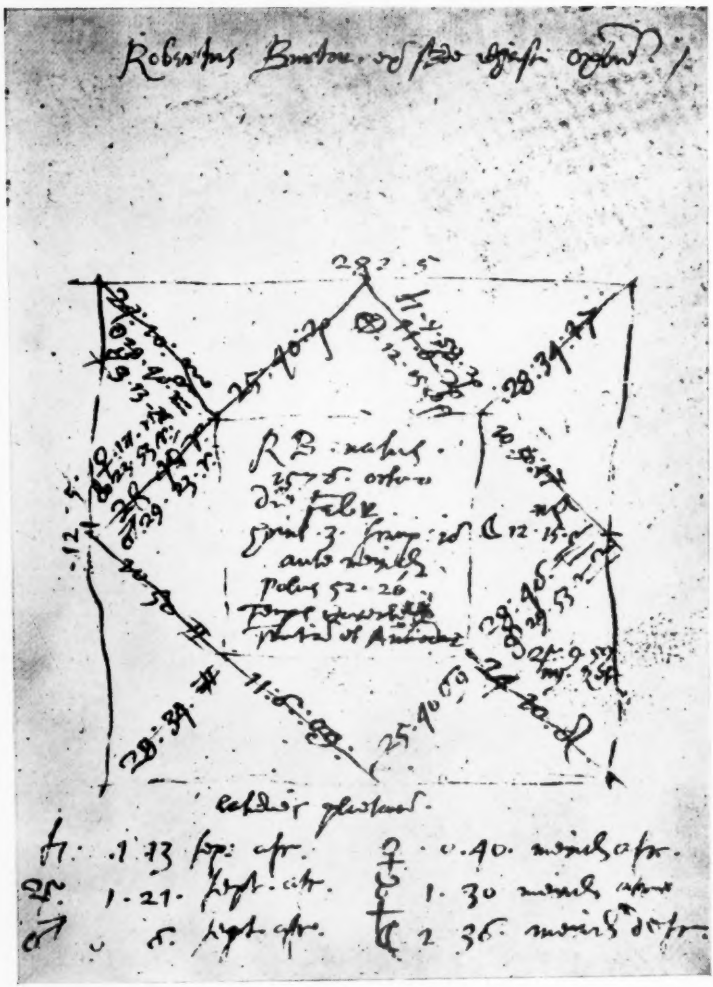
If the above hypothesis is correct the novae will give important data as to the physical conditions required for the production of the nebular lines, for in the life of these objects there is the genesis of a nebula. The nebular lines are produced in the expanding shell of gases surrounding the nova, and the predominating physical change seems to be that of decreasing density. One would be able to compute the change in density from the outburst of the nova till the appearance of the nebular stage, which is generally considered to be at the time of the appearance of the two nebular lines in the green.

In the case of Nova Aquilae 3 there are very good data on the rate of expansion of the shell.[3] The mean rate obtained is about 1700 km/sec. The appearance of the nebular lines is about nineteen days after outburst (the interval of time is somewhat uncertain because of the differences of opinion of the various observers as to the exact time of appearance of the N_1, N_2 lines). The spectral type of the nova before outburst seems to have been type A but the exact subdivision is unobtainable because of the faintness of the Harvard spectrograms. The absolute magnitude before outburst is given by Hubble and Duncan as $+2.7$. These last two data indicate that the star belonged to the main sequence. The stars of the main sequence have nearly the same diameters, about that of the sun, the earlier types tending to be a little larger and the later types a little smaller.

The computation of the density of the shell of gas at the time of the appearance of the nebular lines rests on the assumptions that the density and radius of the original shell of gas are known, that the shell is moving outward with a uniform velocity, and that the thickness of the shell remains constant. The density may be obtained from assuming a pressure of 10^{-4} atmospheres, a temperature of 8000° K, and a mean molecular weight of 20. This gives a density of about 10^{-9} grams per cubic centimeter for the reversing layer of the star before outburst. Using this value and the original radius as that of the sun, the density of the expanding shell of gas at the time of appearance of the nebular lines is found to be 4.6×10^{-17} grams per cc. This is about ten times the density obtained for planetary nebulae.[4] Eddington from a theoretical discussion obtains a density for nebulae of about 10^{-20} grams per cc.[5] The value of the density gotten from the nova is an upper limit to the density and would be many times the mean densities which are quoted above.

One can obtain some idea of the mean free path of the atoms by assuming the particles as neutral and employing the usual kinetic theory formula. Taking the mean atomic weight as 10, the free path is of the

[3] Hubble and Duncan, *Ap.J.*, **66**, 59, (1927).
[4] Russell, Dugan, and Stewart, "Astrophysics and Stellar Astronomy," p. 835.
[5] Eddington, "Internal Constitution of the Stars," p. 382.



THE HOROSCOPE OF ROBERT BURTON.

order of 1400 km. In order to find the mean time between impacts it is necessary to divide this length by the mean velocity of the particles. For a gas of atomic weight 10 and at a temperature of 8000° the velocity is 4.5 km/sec. This gives as the time between impacts an interval of about 300 seconds. According to the theory, the appearance of the nebular lines in the nova shell corresponds to a density such that the life of the atom in the metastable state is about the same as the interval of time between impacts. This gives approximately a hundred seconds for the life of a doubly-ionized oxygen atom in the excited metastable state.

DEARBORN OBSERVATORY, 1927 Nov. 19.

BURTON'S HOROSCOPE AND THE DATE OF HIS BIRTH.

By FLORIAN CAJORI.

Robert Burton, writing before the time of Milton, was the author of an ingenious book, the *Anatomy of Melancholy*, "sparkling with rude wit and shapeless elegance," and even to modern readers a repository of amusement and quaint sayings.

The year of the birth of Robert Burton has been in doubt. It is known to be either 1576, 1577, or 1578, but all authorities agree that he was born at Lindley in Leicestershire, England, on February 8. A few years ago Sir William Osler and Professor Edward Hensly found among Burton's old papers at Oxford a horoscope, drawn up by Burton in his own hand, but unfortunately the date is illegible. The editor of a new edition of Burton's *Anatomy of Melancholy* sent to the present writer a photostat of the horoscope with the request that he determine, if possible, the correct date from the positions of the planets in the horoscope.

Horoscope computation is ordinarily somewhat arduous, especially when, as in this case, there are no regular astronomical ephemerides reaching back to the years in question. It occurred to the present writer that the desired data might be easily ascertained by comparing the positions of Jupiter and Saturn in this horoscope with their positions, respectively, in other horoscopes. The distance of Jupiter from the sun is over five times the distance of the earth from the sun. Jupiter makes a complete revolution in its orbit in 11.862 years; its mean annual motion in the zodiac is over 30°. In view of these facts the displacement of its real position in the zodiac, when seen by an observer on the earth, is negligible for our purposes. Saturn is at a still greater distance from the sun, and takes 29.464 years for its orbital revolution. As its mean annual motion over the zodiac is only about 12° and its orbit has greater eccentricity than that of Jupiter, it is not quite as reliable in our mode of approximation.

An examination of Burton's horoscope exhibits Jupiter ♃ located at 9° 59′ in a triangle ("house") marked at the initial position 24° 20′ in Leo ♌ and at the final position 28° 45′ (?) in Libra ♎. Between Leo and Libra is located Virgo ♍. The question arises, is Jupiter's 9° 59′ a position in Virgo or in Libra? The 9° 59′ is placed nearer to the Virgo sign than to the Libra sign, and therefore belongs to Virgo. That this mode of interpretation is correct can be verified by reference to William Lilly[1] and other writers.

In Burton's horoscope, Saturn ♄ is placed in the "house" having the initial line 28° 34′ Sagittarius ♐, and the final line 11° 5′ (?) Capricorn ♑. Clearly, Saturn is in 9° 58′ Capricorn.

Taking the planet Jupiter, let us compare Burton's horoscope with that of Edward VI, (Oct. 11, 1537), cast by the Italian mathematician Cardan.[2] In the latter, Jupiter appears in the sign of Taurus at 18° 41′. In passing from this position to Burton's position Virgo 9° 59′ we go through the intervening signs of Gemini, Cancer, and Leo; the number of degrees traversed is

$$11° 19′ + 30° + 30° + 30° + 9° 59′ = 111° 18′$$

The difference in time between the two horoscopes, assuming 1576 as the year of Burton's birth, is 38.32 years. In that time Jupiter swept in the zodiac over a number of degrees x, approximately defined by the following proportion:

$$11.862 : 38.32 = 360° : x, \therefore x = 1162° 54′$$

This indicates that Jupiter made in 38.32 years three complete orbital revolutions and 82° 54′ over. This residue differs considerably from 111° 18′. If we repeat the computation, but take 1577 in place of 1576 as the date of Burton's birth, the residual number of degrees is 113° 18′; if we take the year 1578, the number of degrees is 143° 42′. It appears, therefore, that the year 1577 gives an agreement which is as close as could be expected in this approximation. Hence the position of Jupiter in Burton's horoscope *indicates 1577 as the year of his birth.*[3]

Using the planet Jupiter, we have made comparisons of Burton's horoscope with several other horoscopes and have reached the same conclusion in every case. Similar computations with Saturn point to the same conclusion, but not so convincingly. The results of our computations are as follows:

[1] See *An Introduction to Astrology*, by William Lilly; also *A Grammar of Astrology*, by Zadkiel, London, 1913, pp. 156, 157, and pp. 90, 91, 104, 238, 259, 260.

[2] The horoscope of Edward VI is copied by W. W. R. Ball in his *Mathematical Recreations*, London, 1892, p. 187.

[3] In the inner square of Burton's horoscope the year of birth appears to be either 1576 or 1578. The date 1576 agrees with our result, if we interpret Feb. 8, 1576, to be "Feb. 8, 1576-77." In England, before 1752, the legal year began on March 25, so that Feb. 8, 1576-77, of a year beginning March 25 stood for the same day as Feb. 8, 1577, of a year beginning Jan. 1. In 1752, not only was the Gregorian calendar introduced in England, but the legal year was changed so as to begin on Jan. 1.

			Computed Difference	Horoscope Difference
			° ′	
Edward VI, Oct. 11, 1537	Burton, Feb. 8,	1576	82 54	Jupiter
	Burton,	1577	113 18	111° 18′
	Burton,	1578	143 42	
Charles I,[4] Jan. 30, 1648-49	Burton,	1576	54 48	Jupiter
	Burton,	1577	24 16	28° 55′
	Burton,	1578	—6 16	
Goethe,[5] Aug. 28, 1749	Burton,	1576	227 54	Jupiter
	Burton,	1577	197 36	196° 12′
	Burton,	1578	167 18	
Am. Independence,[6] July 4, 1776	Burton,	1576	37 54	Jupiter
	Burton,	1577	68 18	64° 01′
	Burton,	1578	98 42	
Edward VI, Oct. 11, 1537	Burton,	1576	108 12	Saturn
	Burton,	1577	120 27	113° 09′
	Burton,	1578	132 42	
Charles I, Jan. 30, 1648-49	Burton,	1576	171 36	Saturn
	Burton,	1577	159 30	149° 27′
	Burton,	1578	147 24	
Goethe, Aug. 28, 1749	Burton,	1576	39 24	Saturn
	Burton,	1577	51 30	54° 53′
	Burton,	1578	63 36	
Am. Independence, July 4, 1776	Burton,	1576	71 24	Saturn
	Burton,	1577	83 48	85° 08′
	Burton,	1578	96 12	

UNIVERSITY OF CALIFORNIA.

MORNING AND EVENING STARS FOR 1928.

By FREDERIC R. HONEY.

The study of Planetary Configurations is very much facilitated by an inspection of a plot of the solar system, in which the positions of the planets are shown for the current year.

Since the planes of the orbits of the planets are inclined at small angles to the plane of the ecliptic, in plots of dimensions which are brought within the limits of this page the orbits may be represented by eccentric circles. Should they be drawn to a large scale, the ellipticity of the orbits of Mars and Mercury would be apparent.

Figure 1 represents the orbits of the Earth, Mars, and Venus, and the positions of the planets for the first day of each month; and the orbit of Mercury, showing its position at intervals of eleven days for the first revolution. The dates for the remaining three revolutions of Mercury may be found in the *Nautical Almanac*.

[4] *Introduction to Astrology*, by William Lilly, etc., London, 1913, p. 290. Death of Charles I; Jupiter appears here in Libra 8° 54′, and Saturn in Gemini 9° 25′.

[5] F. Boll, *Sternglaube und Sternkunde*. Leipzig und Berlin, 1918, p. 85. Jupiter appears here in Pisces 26° 11′; Saturn in Scorpio 15° 5′.

[6] *New International Cyclopaedia*, Art. "Astrology." Jupiter appears here in Cancer 5° 58′; Saturn in Libra 14° 50′.

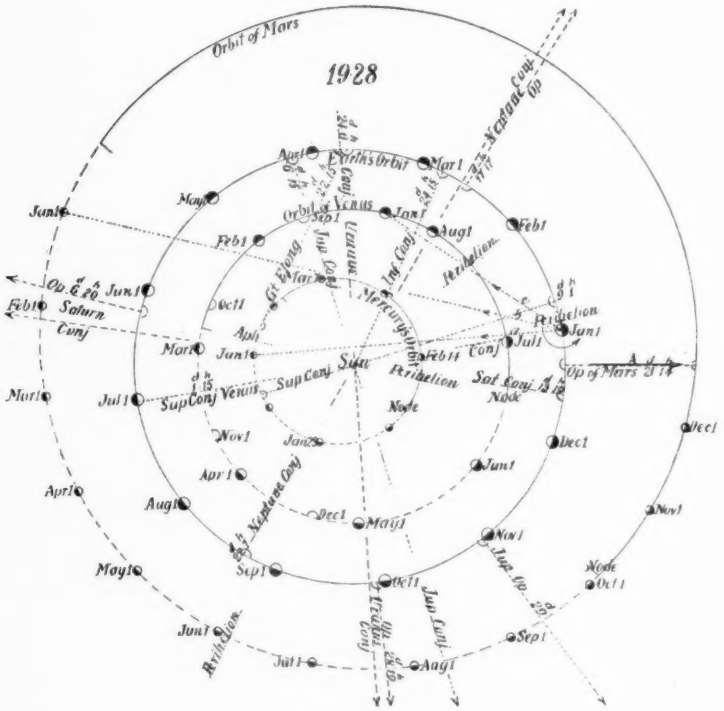


FIGURE 1.

In Figure 2 the scale is very much reduced. The orbit of Mars is repeated in order to show the continuity of the solar system. In this figure the positions of each planet are shown for the first and last days of the year.

To assist the reader in the determination of the positions of the planets with reference to the Celestial Sphere, the projection on the plane of the ecliptic of an arrow is shown at *A*. It is inclined at an angle of 66° 33′ to the ecliptic, that is to say, it is parallel to the earth's axis, and points to the pole of the heavens. In Figure 1 the projection very nearly coincides with the radius vector of Mars at the date of opposition.

It is not possible to do more than indicate a few of the configurations without introducing confusion into the drawings. The earth rotates in the direction of the arrow (Jan. 1); and the arrows *a*, *b*, and *c*, respectively, indicate that Mercury, Mars, and Venus (Fig. 1) are above the horizon before sunrise; also that Neptune and Saturn (Figs. 1 and 2) are above the horizon before sunrise; and that Jupiter and Uranus

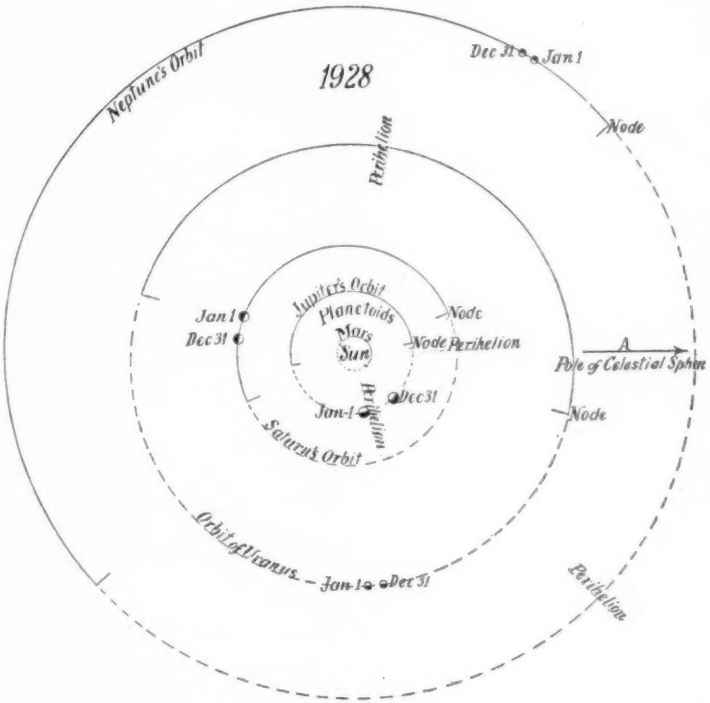


FIGURE 2.

(Figs. 1 and 2) are above the horizon after sunset.

For the first revolution Mercury reaches superior conjunction Jan. 9; inferior conjunction Feb. 24; and greatest elongation March 22, when the planet may be seen to good advantage before sunrise.

The reader is referred to the *Nautical Almanac* for the dates of Mercury's configurations for the remaining three revolutions.

Venus is above the horizon before sunrise until July 1, the date of superior conjunction; and for the remainder of the year will be evening star.

Mars comes to opposition December 21;

Jupiter. Conjunction April 6; Opposition October 29;

Saturn. Opposition June 6; Conjunction December 13;

Uranus. Conjunction March 24; Opposition September 28;

Neptune. Opposition February 17; Conjunction August 22.

TRINITY COLLEGE, HARTFORD, CONNECTICUT.

REPORT OF THE MEETING AND EXHIBITION COMMEMORATING THE BICENTENARY OF THE DEATH OF SIR ISAAC NEWTON.

By FREDERICK E. BRASCH.

The fourth annual meeting of The History of Science Society was held in pursuance of an act of its Council of last year, to commemorate the bicentenary of the death of Sir Isaac Newton. In view of this unusual occasion, and of the manifold interests Newton had, it was therefore considered expedient to ask those societies most interested to coöperate by appointing representatives on the Committee preparing the program. The following are the names of those who served:

COMMITTEE ON PROGRAM.

Dr. R. C. Archibald, Brown University, Dr. E. W. Brown, Yale University, Dr. Florian Cajori, University of California, representing The American Mathematical Society and The Mathematical Association of America.

Dr. A. O. Leuschner, University of California, Dr. Frederick H. Seares, Mount Wilson Observatory, representing The American Astronomical Society.

Dr. Leigh Page, Yale University, representing the American Physical Society.

Dr. David Eugene Smith, *Chairman*, Columbia University, Dr. Henry Crew, Northwestern University, representing The History of Science Society.

Mr. Frederick E. Brasch, Library of Congress, *Secretary to the Committee.*

The meeting was called to order by the President of The History of Science Society, Dr. David Eugene Smith, at 10:00 o'clock A.M. Friday, November 25, 1927, in the Educational Hall of the American Museum of Natural History, New York City.

The two days program consisted entirely of papers on various phases of Sir Isaac Newton's contributions to Astronomy, Mathematics, Physics, Chemistry, Religion, problems of the mint, and the development of science since his day; also some indication of Newton's influence on the early science in the American Colonies from 1687 to 1779. Two papers were devoted to each subject and these were given by scholars of distinction—from both the United States and Canada. Twelve papers, reviewing Newton's work from the present historical standpoint, made what is probably one of the most notable of single contributions to scientific literature. These addresses are to be published (by The History of Science Society) in a memorial volume.

The object of this American Commemoration was twofold; first to honor the great name of Newton, and second to acquaint the younger generation of students, as well as the public at large, with the contributions made in the various fields of knowledge in which Newton labored. From the standpoint of interest and attendance, the meeting was successful.

Old England may justly feel proud of the recognition America (United States) has accorded her greatest philosopher. Similar celebrations have taken place elsewhere. Particularly we note the program given in Grantham, Newton's birthplace, on Saturday, March 20, 1927, the exact date of the bicentenary of his death, which was attended by many of the greatest scholars of the British Empire, as well as by representatives from abroad. Both commemorations will go down in history and furnish most interesting recapitulations of Newton's influence in the history of science and civilization.

Following the abstracts of papers presented, a brief account of the exhibition is given. Dr. David Eugene Smith, Chairman of the first morning program, gave the introductory address. He spoke of the occasion of the "Commemoration" and of the life of Sir Isaac Newton. He said in part:

OPENING REMARKS BY DR. DAVID EUGENE SMITH, PRESIDENT OF THE HISTORY OF SCIENCE SOCIETY.

"We come here today for two major purposes: First, to pay our respects to the memory of a man who is rated by the world as one of its greatest geniuses; and Second, to weigh once more, by modern criticism if not by scales of precision, the world's claim that its judgment is just.

"Of the esteem in which Newton's work has been held for two centuries there is no question. Few men have ever fared so well. The justness of that esteem has, however, been seriously questioned by various scholars of reputation. There have been assertions that his word was not 'as good as his bond'; that his influence upon British mathematics was not salutary; that he abandoned the altar of science for the fleshpots of Egypt; that the foundations of his greatest mathematical theory were weak and the theory was unstable; and that he stands as a fetich for the unthinking worship of the Anglo-Saxon. Nor have there been lacking expressions to the effect that, had he been the great genius that England asserts, his countrymen would long since have given to the public a definitive edition of his complete works, his correspondence, and his papers. Such editions are a common tribute paid by nations or societies to the memory of their great men. Why should England have published the monumental editions of Cayley's and Sylvester's works, and yet have so neglected Newton and have allowed the Portsmouth papers to lie practically in oblivion? Was there not, back of all the praise, a feeling that the nation had risen to his defense in an inglorious dispute, but that at heart it doubted his greatness?

"These questions have not been raised merely by men of no intellectual capacity who seek a place in the limelight by decrying the work of others; by those who, as a French philosopher has put it, rail at greatness because they cannot achieve it. They come from honest-

minded men who really wish to know what it was that Newton accomplished to make him worthy of the acclaim that has been accorded him; who ask for an answer, without excess of praise, to the justifiable question, 'What were Newton's real contributions to world knowledge?' To give and to receive this answer is one of the purposes of our meeting. The answer, however, cannot be given with authority by any one man or by any small group of workers in a single field; it can come only from several men, representing the various major fields in which Newton showed an interest. It is with this thought in mind that representatives from different learned societies have been requested to place before other scholars a series of succinct but authoritative statements of his achievements.

"When we review his life, his idiosyncracies, his periods of contrast, and his doubts and ambitions and desire for place, may we not take some pleasure in thinking of him as a man,—a man like most other men save in one particular,—he had genius,—a greater touch of divinity than comes to the rest of us?

"The questions to be answered by the speakers will relate chiefly to Newton as a scholar, and upon the answers will depend our judgment of the justice of the praise that has been given him. One thing will not fail to stand out clearly, however,—that few men have ever lived who explored so successfully as wide a range of human activities, and few who could so justly have used the well-known phrase,

Homo sum, et nihil humani a me alienum puto."

The second paper was given by Dr. Dayton C. Miller of the Case School of Applied Science who spoke on

NEWTON AND OPTICS.

"This convocation is held to commemorate the Bicentenary of the death of Sir Isaac Newton which occurred in London on March 20, 1727. We are not now just discovering Newton's greatness; in his own lifetime he was regarded as the greatest man in intellectual achievement that the world had known; the greatest possible posthumous honors were done him. . . Voltaire, a contemporary, said of Newton: 'If all the geniuses of the universe were assembled, he should lead the band.' The appreciation of his greatness has continually increased during the two centuries that have elapsed since his death. . . .

"In the year 1668, Newton made the first reflecting telescope, but he had not yet discovered the nature of the spectrum, for in 1669 he helped Dr. Barrow in the publication of Barrow's lectures on Optics, in which an erroneous theory of color is set forth. . . .

"In the year 1668, Newton made the first reflecting telescope, but he and the fame of his researches, especially in optics, began to spread. He was proposed as a candidate for admission to the Royal Society in December, 1671, and was asked to send the reflecting telescope to the

Society for inspection. The instrument was sent to London, and was exhibited before the Society on January 11, 1672, at which time a description of the telescope was read, and Newton was elected a Fellow of the Society. This telescope has ever since remained with the Society as one of its most cherished possessions. Newton was very much pleased with the honor of election to the Royal Society, and his acknowledgment to the secretary, sent one week later, says:

> 'I desire that in your next letter you will inform me for what time the society continue their weekly meetings; because, if they continue them for any time, I am purposing them to be considered of and examined on account of a philosophical discovery, which induced me to the making of the said telescope, and which I doubt not but will prove much more grateful than the communication of that instrument, being in my judgment the oddest if not the most considerable detection which hath hitherto been made into the operations of nature.'

"This promise was fulfilled by a communication which was read just one month later, and the 'considerable detection into the operations of nature' proved to be the complete explanation of the nature of the solar spectrum, and the true theory of color. . . .

"Nothing more was done in the domain of optics, until, in 1704, Newton published the first edition of his book called 'Opticks; or a Treatise of the Reflections, Refractions, Inflections and Colours of Light.' There were slight additions made in the second edition which appeared in 1718. For our present purpose, it seems desirable to give a description of the contents of this book, which covers all of Newton's work in optics, and to make a kind of inventory of the optical developments due directly to his work, as interpreted in the light of the third century following their origin. . . .

> 'Rays of Light, by impinging on any refracting or reflecting Surface, excite vibrations in the refracting or reflecting Medium or Substance, and by exciting them agitate the solid parts of the refracting or reflecting Body, and by agitating them cause the Body to grow warm or hot; that the vibrations thus excited are propagated in the refracting or reflecting Medium or Substance, much after the manner that vibrations are propagated in the Air for causing Sound, and move faster than the Rays so as to overtake them; and that when any Ray is in that part of the vibration which conspires with its Motion, it easily breaks through a refracting Surface, but when it is in the contrary part of the vibration which impedes its motion, it is easily reflected; and, by consequence, that every Ray is successively disposed to be easily reflected, or easily transmitted, by every vibration which overtakes it. But whether this Hypothesis be true or false I do not here consider.
>
> 'The returns of the disposition of any Ray to be reflected I will call its Fits of easy Reflexion, and those of its disposition to be transmitted its Fits of easy Transmission, and the space it passes

between every return and the next return, the Interval of its Fits.' (p. 256) . . .

"It has been very generally stated that Newton adopted and developed the corpuscular theory of light, in which light consists of small particles and nothing else. This interpretation was really thrust upon him by his successors, for he was always exceedingly careful not to commit himself to any specific theory of the structure of light. Thirty years before his Treatise appeared, when he was actively engaged in the optical researches, and was sending reports to the Royal Society, he wrote to Hooke, saying: 'Were I to propound an hypothesis it should be this, that light is something capable of exciting vibrations in the ether.' Again he says: 'The hypothesis of light being a body, had I propounded it, had a much greater affinity with the objector's own hypothesis (Hooke's Undulatory Theory) than he is aware of, the vibrations of the ether being as useful and necessary in this as in his.' .

"The science of light today is indebted to Newton not alone for his discoveries in optics, but in a greater degree to his general influence upon the methods of philosophic thought. The discovery of universal gravitation is the discovery of the law of universal order, which is the basis and essential character of all science. The example of such profound and comprehensive philosophizing has been one of Newton's contributions to optics as well as to other sciences.

"And now, two hundred years after the death of Newton, we, in behalf of the science of optics, wish to join the great chorus of all the sciences in doing reverence to him, not for what he was, but for what he has been for these centuries, and for what he is now. We repeat the inscription on the Westminster Tablet which was erected in 1731:

LET MEN REJOICE
THAT SO GREAT A GLORY OF THE HUMAN RACE
HAS APPEARED."

The third address was by Dr. G. D. Birkhoff of Harvard University who referred to Newton's Philosophy of Gravitation with special reference to the Modern Relativity Idea.

"Up to the time of the ancient Greeks, scientifically-minded men had accumulated comparatively few experimental facts. For the description of these facts ordinary geometrical space and measurable time, which seemed self-evident, were available. Copernicus took the space attached to the sun to be at rest. On this basis Kepler deduced his three laws of planetary motion and was led to correct ideas about the forces of gravitation. Newton's greatest achievement lay in overcoming many mathematical difficulties and establishing the laws of gravitation and of motion known by his name. It was stated that Newton's scientific procedure was according to the best general principles. The reason for the recent progress to the relativistic theory of gravitation was found

in the accumulation of evidence that the physical universe is basically electro-magnetic, rather than dynamical. Nevertheless the Newtonian dynamical theory of space, time, and gravitation will always stand as the first and simplest approximation to the facts."

The final paper on the morning program was given by Dr. W. W. Campbell, President of the University of California, who spoke on

NEWTON'S INFLUENCE UPON THE DEVELOPMENT OF ASTROPHYSICS.

"Astrophysics is concerned with *what* the stars, comets, nebulae, and other celestial bodies really are, and *why* they are *as* they are. Spectrum analysis, the most remarkable, the most fruitful system of analysis in existence, rests upon Sir Isaac Newton's discovery that white light—Sunlight, starlight—contains light of all known pure colors,—really an infinite variety of colors. When star-light is passed through a telescope and a spectrograph attached thereto, the light records a message on the photographic plate—the star's spectrum—which describes precisely the conditions prevailing in that star. The finding of spectroscopic Rosetta stones, by Kirchhoff in 1859, and by his many successors in our physical laboratories, is enabling us to read the messages which many thousands of stars have sent to us and written down for us. These messages tell us what chemical elements and compounds, in the form of vapors and gases, are present in the outer strata of the stars, in comets, in the many kinds of nebulae. They tell us that our chemical elements are widely—perhaps universally—distributed throughout the universe. They tell us whether a given star is approaching us or receding from us, and with what speed; that a certain star is a giant or a dwarf star, and how far away it is; and a seemingly endless procession of facts relating to the conditions existing in the stars and other heavenly bodies.

"The law of gravitation, discovered by Newton, is enabling us to learn much concerning conditions in the interiors of the stars, the comets, and other objects.

"Sir Isaac, with his own hands, constructed and used the first reflecting telescope, the forerunner of the giant reflecting telescopes of today.

"Newton developed a *preference* for the corpuscular theory of light, as opposed to the undulatory or wave theory. To this end he may have been influenced by the difficulty of understanding why light radiations escaped paying toll for their transmission through space by wave motion. In the last year or two many physicists—notably de Broglie, Schroedinger, and others—appear to be advocating a combination of the corpuscular and undulatory theories of light, as Newton himself very definitely did. Astrophysicists will be tremendously interested to learn the real nature of light, so that they may apply its principles to the

solution of many of their most difficult problems, such as those of stellar evolution.

"Sir Isaac Newton was uniquely the great pioneer in astrophysics."

(To be continued.)

AMERICAN ASTRONOMICAL SOCIETY.

REPORTS OF OBSERVATORIES
1926-1927

[*Continued from page 571, Vol. XXXV.*]

DUDLEY OBSERVATORY

ALBANY, NEW YORK

Reductions of Observations. The manuscript of the San Luis Catalog of positions of 15,333 stars has been sent to the printer and should be ready for distribution early in 1928. The reductions of the Albany observations are rapidly nearing completion. The final positions have been derived and the mean dates and mean positions for 1910.0 are being formed. Progress has been made in the computation of the refractions and apparent place corrections for the reductions of Flint's Madison observations.

Variation in the Rate of Rotation of the Earth. From an investigation of the periodic annual term in the right ascensions of the stars from 1830 to 1925 Mr. Boss has found a systematic change in this term which follows the minor fluctuations of the moon. It has previously been shown that the sun, moon, Venus, Mercury, and Mars are subject to secular changes in position arising from the same source, which has been traced to a variable rate in the rotation of the earth. Evidence from the star observations is now added. Moreover, a step further has been taken in tracing the source of the disturbance for, whereas a secular change of rotation of the earth was assumed to cause secular changes in the positions of the bodies above mentioned, the evidence from the star positions indicates at least an annual change in rate with a secular change in the amount of the annual variation. A seasonal, or annual, change may be produced either by a true seasonal or a diurnal variation. If there were a diurnal change in the rate of rotation of the earth, the effect should produce a monthly variation in the position of the moon. Definite evidence of such a variation was found. The existence of a diurnal term affecting clock corrections lends further cor-

roboration. Thus the evidence points strongly to a diurnal change in the rate of rotation of the earth. An explanation is suggested in tides upon the body of the earth.

Chandler-Pond Catalog. Mr. Raymond has completed Chandler's reductions of a series of double-altitude observations made by Pond at Greenwich in 1825-35 with two mural circles, deriving the declinations of 93 stars for the epoch 1830.0. These reductions add considerably to the value of the Pond positions which, due to their age, have appreciable weight in the determination of the errors of the modern systems of proper-motions in declination.

The K-Term in Radial Velocities. It was pointed out by Campbell in 1910 that the mean peculiar radial velocity of the stars, taking account of sign, did not vanish as it should if the motions were at random. Rather large positive values of this quantity in spectral classes B, K, and M seemed to point to a real effect, which was interpreted by some investigators as evidence of an expanding universe. Mr. Wilson has shown that the tripling of the data alone since 1910, with its consequent reduction of the purely statistical errors, has practically eliminated this effect from all the spectral classes except B, in which class, as others have shown, several causes may operate to produce a positive mean radial velocity.

Stellar Wave-Lengths. In addition to further study of the Class-B stars, Mr. Albrecht has begun a coöperative program with the Yerkes Observatory. A first installment of 29 three-prism spectrograms, measured with a Palo daylight lamp as a constant light source, has been used in the construction of reduction tables on the international system of wave-lengths. A study of the titanium comparison spectra showed that a few of the strongest lines should be excluded as reference lines.

BENJAMIN BOSS, *Director.*

GOODSELL OBSERVATORY

CARLETON COLLEGE

NORTHFIELD, MINNESOTA

The following changes in personnel occurred: Mr. Clifford E. Smith was appointed instructor in astronomy and mathematics; Messrs. Merten Hasse and Charles Chapman were appointed fellows in astronomy.

As usual the time of the staff was largely devoted to teaching classes in astronomy and mathematics.

Photographic observations of asteroids by Professors Wilson and Gingrich for the years 1923-24 were published as No. 11 of *Goodsell Observatory Publications* and distributed to observatories and individuals in January, 1927.

An elementary text book on astronomy by the undersigned was published by the McGraw-Hill Book Company in July, 1926.

A series of plates was taken and measured to test the quality of the 16-inch Brashear objective by the Hartmann method. The lens proves to be of high quality.

The instrument shop was made more efficient by the addition of a 15-inch lathe. Minor pieces of apparatus were constructed.

The library was increased by 100 bound volumes obtained by purchase or gift. In addition 582 volumes, previously unbound, were bound.

The observatory was open to the public on Saturday nights during the college year.

E. A. FATH, *Director.*

KODAK RESEARCH LABORATORIES

ROCHESTER, NEW YORK

Reciprocity Law. Two further communications have been published on this subject. In the first[1] it was shown that the maximum density which can be obtained, by any values of exposure ($I \cdot t$) and by development to completion, is a function of the intensity factor of exposure. Thus when I is low it is impossible to obtain D_∞, the density resulting from the development of all of the silver halide grains in the emulsion. It was shown further that for radiation to which the material has but little sensitivity, there is an enormous failure of the reciprocity law in the region of intermediate intensity. In the region of very low intensities there is but little departure from the reciprocity law and at higher intensities the Kron-Halm catenary equation applies. In the second communication[2] further data were given which show that the Kron-Halm formula

$$It = \frac{I_0 t_0}{2}\left[(I/I_0)^a + (I/I_0)^{-a}\right]$$

fits the observed values very well in the region of medium and high intensity values. The observed values depart markedly from this equation where low intensities are used. The major effect of extending the time of development was shown to be a shift of optimal intensity toward higher values without any appreciable effect upon curvature. A study of different developing agents indicates that this factor has very little influence upon the relation between the values of optimal intensity, I_0, and the curvature as expressed in terms of a.

Resolving Power. The resolving power of photographic materials has been investigated further.[3] It has been shown that values of resolving power derived from a "fan" test object are not identical with those based on the use of a parallel line test object. It has been shown

further that the resolving power values are dependent upon the ratio of line to space in the test object. The relation between resolving power and the logarithm of the ratio obtained by dividing width of line by width of space is linear.

Color Sensitizing.[4] The spectral sensitivity conferred by bathing photographic plates in various dye solutions has been determined for the more important dye sensitizers including Erythrosine, Pinachrome Violet, Dicyanine A, Kryptocyanine, and Neocyanine. The color sensitivity is illustrated by means of wedge spectrograms. A method of hypersensitizing by use of ammonia is also described.

Photographic Spectrophotometry in the Ultra-Violet Region.[5] The various precautions which must be taken in order to avoid errors in the application of photographic methods to spectrophotometric measurements are discussed and a method proposed whereby these errors can be entirely eliminated or minimized.

[1] L. A. Jones, V. C. Hall. *On the Relation between Time and Intensity in Photographic Exposure.* IV. J. O. S. A. & R. S. I. **13**: 443, 1926.

[2] L. A. Jones, V. C. Hall, and R. M. Briggs. *On the Relation between Time and Intensity in Photographic Exposure.* V. J. O. S. A. & R. S. I. **14**: 223, 1927.

[3] Otto Sandvik. *On the Measurement of Resolving Power of Photographic Materials.* J. O. S. A. & R. S. I. **14**: 169, 1927.

[4] M. L. Dundon. *Color Sensitizing Photographic Plates by Bathing.* Amer. Phot. **20**: 670, 1926. Brit. J. Phot. **73**: 748, 1926. Phot. Rund. **64**: 30, 1927.

[5] *Photographic Spectrophotometry in the Ultra-Violet Region.* Lloyd A. Jones. Bul. Nat. Research Council No. 61, 1927.

C. E. K. Mees, *Director.*

OBSERVATORIO ASTRONOMICO

UNIVERSIDAD NACIONAL

LA PLATA, ARGENTINA

(For the year ending June, 1926)

There have been no changes in the staff.

The equipment has been increased by the purchase of a five-inch Bamberg portable telescope with equatorial mounting. As the dome of the 215 mm equatorial, which has always been inconvenient, was out of repair, the instrument has been dismounted and is out of commission pending the construction of a new dome. A new Wiechert vertical seismograph with 80 kg steady mass has been installed.

Considerable observing was done in the meridian circle zone E, —72° to —82°, and work has been continued in the preparation for publication of zones B, —57° to —62° and D, —66° to —72°. The work in the Kapteyn areas is finished ready for printing. One observation each was obtained on the southern stars of the Eros list.

The photometric observations of Nova Pictoris were continued till

November, 1925, and the spectroscopic observations till April, 1926, when they were interrupted by Dr. Hartmann's absence on leave.

The time service has been increased by the sending of a signal at 11 o'clock, Argentine Standard Time (15^h G.C.T.) through the broadcasting station of the University. The seismic and meteorological observations have been continued.

Aside from communications to various periodicals, the works printed during the year have been Nos. 1 and 2 of Volume I of seismological investigations, beginning a new series of *Contribuciones Geofisicas*, separate from the *Publicaciones*.

J. HARTMANN, *Director*.

LEANDER McCORMICK OBSERVATORY

UNIVERSITY OF VIRGINIA

Photographic work on stellar parallaxes and on proper motions continues without material changes. The second parallax volume has been distributed as *Memoir of the National Academy of Sciences*, Volume XXII and as *Publications of the Leander McCormick Observatory*, Volume IV. The details of the parallaxes of 700 stars have thus been published. Up to date 850 parallaxes have been completed and 23,000 plates taken. The first parallax plates of this observatory are now thirteen years old. With this interval, relative proper motions can be determined with a probable error of $\pm 0''.002$.

From money given by Mr. John Armstrong Chaloner of Virginia an eclipse expedition was sent to Fagernes, Norway. The director of the Observatory was attempting to photograph the flash spectrum from the extreme ultra-violet to the deep infra-red, using plates stained with neocyanine. The instruments taken to Norway belonged mainly to the U. S. Naval Observatory, Allegheny Observatory, and Harvard University. More than twenty Americans were present at Fagernes on the day of the eclipse. Among those who actively took part in the work were: S. A. Mitchell, Professor H. T. Stetson of Harvard University, Dr. M. S. Kovalenko of Swarthmore, Dr. A. C. G. Mitchell of California Institute of Technology, Mr. H. McM. Godley of New York, Professor Chas. E. Rogers of Trinity College, Dr. Elihu Thomson of General Electric Company. Unfortunately, clouds prevented the securing of photographs.

S. A. MITCHELL, *Director*.

LICK OBSERVATORY

UNIVERSITY OF CALIFORNIA

MOUNT HAMILTON, CALIFORNIA

Upon the retirement of Dr. Tucker, Dr. Jeffers was placed in charge of the department of meridian observations. New appointments are: Dr. Donald H. Menzel, assistant astronomer, with principal duties in the spectrographic department; Dr. T. S. Jacobsen, assistant in the same department; Miss Phyllis Hayford, computing assistant. Miss Dorothy Applegate, computing assistant, resigned her position on January 1, 1927.

Professor Joel Stebbins was in residence for six weeks in August and September, 1926, engaged in observations of the satellites of Jupiter with the photo-electric cell photometer, attached to the 12-inch telescope. His discussion of these observations is printed in *L. O. Bulletin* No. 385.

President Campbell made several short visits to the Observatory during the year. His time on these occasions was largely given to work and consultation with Mr. Moore on the radial velocity volume referred to in the following paragraphs.

Mr. Moore, who has been in active charge of the program for determining the radial velocities of the stars since 1923, has secured 519 spectrograms during the year, with the assistance of Messrs. Menzel, Jacobsen, and Maxwell. Since the general program of observing the radial velocities of all stars to 5.5 visual magnitude has been completed, the program for the year included bright stars of which no observations had been made at Mount Hamilton for fifteen or more years, and stars known to be, or suspected to be, variable in their velocity.

In extension of this general program, Dr. Neubauer, at the Chile Station, secured 275 spectrograms, chiefly of class B stars fainter than 5.5 visual magnitude. About 50 of these were taken with two-prism, the rest with one-prism dispersion. Measurement and reduction of all the spectrograms have been kept well up to date by the observers named and by Miss Applegate, nearly all of whose time was given to this work.

A very large part of Mr. Moore's office time was devoted to the preparation of the general catalogue of radial velocities based upon the observations made at Mt. Hamilton and at Santiago. The volume, including the radial velocities of all stars to 5.5 visual magnitude and a discussion of the solar motion determined from them, was essentially ready for the printer by the end of the year under review. It is expected that it will be distributed during the current year.

In addition to this major program, 100 one-prism spectrograms of stars in clusters and 18 of comparison stars were secured by Mr. Trumpler, in continuation of his program for determining the spectral type and radial velocities of the stars in the open clusters; Mr. Menzel

obtained spectrograms in the visual region for a few early type stars and devoted some time to a study of planetary spectra; Mr. Jacobsen gave special attention to 3-prism spectrograms of some of the brighter Cepheids; and Mr. Neubauer secured further spectrograms of Nova Pictoris. Mr. Moore also secured an interesting spectrogram of the head of the Pons-Winnecke Comet, and, with Mr. L. A. Brigham, several spectrograms of the north limb of the moon at the time of the total eclipse of June 14-15. Dr. C. D. Shane, of the department of astronomy at Berkeley, was in residence during May and June, 1927, and devoted his time to a study of the absolute intensities of the lines in the visible region of the solar spectrum, with the aid of the Moll recording microphotometer.

Messrs. Wright and Trumpler continued their observations of Mars in 1926. Mr. Wright extended his studies, through photography by light of different colors, to include Jupiter as well, utilizing the Crossley reflector. A preliminary account of his work has been published in *L. O. Bulletin* No. 389. His observations have led him to advance the suggestion of an atmosphere on Mars somewhat yellowish in color as viewed by transmitted light. Two types of cloud have been recognized on the planet. Clouds of one type are interpreted as low-lying aqueous clouds, while those of the other are of unknown composition and are believed to lie high in the Martian atmosphere.

The appearance of Jupiter is progressive with the spectral sequence of the colors. The Jovian reactions to color are altogether different from those of Mars and demand interpretations of a different kind. The belt material of Jupiter appears to extend to the surface of the medium in which it floats and the short-waved color photographs are regarded as depicting the surface layers of the medium. The long-waved colors are believed to be more penetrating and to provide representations of a lower level. Mr. Wright's studies of Jupiter will be continued during the favorable opposition of September, 1927.

In continuation of his studies of Mars, made in 1924 (*L. O. Bulletin*, No. 387), Mr. Trumpler, using the 36-inch refractor, made 32 complete drawings of the disk and several detail sketches, and secured about 1500 photographic images of the planet during the year. Experiments proved that a red glass filter and slow lantern slide plates sensitized with Pinacyanol are best adapted to Martian photography with this telescope. Only a preliminary account of these observations has so far appeared (*Publ. A.S.P.* **39**, 103), but this suffices to indicate the interesting knowledge that has been obtained relating to the "canals"; changes in intensity along their course, and even discontinuity were observed on several occasions. Remarkable changes in some regions were observed during the few months observations, and more were revealed by comparison with the observations made in 1924. Some, at least, of these must apparently be due to the advance of the Martian seasons.

Reference, in this connection, should also be made to Mr. Menzel's

coöperation with Coblentz and Lampland in the reduction of the Lowell Observatory measures of the radiation from Mars.

Mr. Aitken continued his measures of close double stars, chiefly those of his own discovery, as opportunity offered. Practically all of his time, not required by administrative duties, was given to the preparation of the Extension to Burnham's General Catalogue of Double Stars. All questions relating to the form and scope of the work were definitely decided, and the work of preparing the printer's copy was begun. Miss Hayford devoted about half her time to computation of precessions for this work, and Mrs. J. H. Moore's services were available during the last quarter of the year to assist in preparing the printer's copy. Sufficient progress was made to warrant the hope that the work may be completed before the close of the calendar year 1928.

In the summer of 1926 Mr. Jeffers visited a number of eastern observatories, including those at Albany, Cincinnati, New Haven, and Washington, to consult with astronomers interested in meridian observations and to observe their methods. Upon his return, the recording micrometer was attached to the Repsold Meridian Circle, the Riefler and other clocks were thoroughly cleaned and adjusted, a temperature contact for the Riefler clock was installed and many minor improvements were made in the general equipment. Observations for longitude, in connection with the World Longitude Campaign, were obtained on eleven nights in November, 1926. The measures have been reduced and are ready for publication. Radio apparatus, partly constructed here, was installed to receive the signals from Washington, Honolulu, and San Diego directly upon our chronograph. The observation of reference stars for Dr. Schlesinger's photographic zone work will begin early in the year 1927-28.

In addition to the meridian work, Mr. Jeffers made a number of comet observations and continued his work on the definitive orbit of Comet Tempel I.

Reference has already been made to some of Mr. Menzel's work. His principal work, however, has been a study of the flash spectrum based upon plates taken at various eclipse expeditions sent out by the Lick Observatory. It is expected that this will result in a complete catalogue of the spectrum from λ 3240 to λ 5300, with intensities, heights, and identifications of the lines. The relation of observational results to certain problems of atomic physics and to the equilibrium of the chromosphere will form part of the investigation. Mr. Menzel's essay on *The Source of Solar Energy*, published in *Science*, vol. 65, p. 431, was awarded the A. Cressy Morrison Prize of the New York Academy of Sciences, in December, 1926. Other theoretical studies made during the year relate to the planetary nebulae and to the accuracy of planetary temperatures derived from radiometric measurements.

Mr. Jacobsen's time was mainly given to the work of observing stars for radial velocity, measuring the plates and making the reductions;

but he also assisted in the photometric observations of Jupiter's satellites, and photographed the Pons-Winnecke Comet and the moon in eclipse with the Crocker telescope. Later he mounted the 5-foot focus Ross lenses on this telescope.

Dr. Yü, Martin Kellogg Fellow, continued his program of observing the brighter normal Class B stars and a few of the brighter Cepheids, with the quartz spectrograph attached to the Crossley reflector. Including also a complete series of observations of ζ Geminorum with the slit spectrograph, 112 plates were secured during the year. The majority of these plates and many of those of Class A stars taken in the preceding year were analyzed with the Moll microphotometer. The 300 tracings thus obtained are now being studied and the results will be published in the near future. Dr. Yü resigned his position here in the summer of 1927, to take up the duties of professor of astronomy in the University of Amoy, China.

Mr. Maxwell utilized the Crossley telescope in a study of the space distribution of the stars of different spectral classes in the Cygnus Region of the Milky Way. His paper (*L. O. Bulletin,* No. 390) gives the classification of spectra in this region for stars between magnitudes 10 and 14, with density curves to a maximum distance of 5000 parsecs. All of these curves show a falling off in density beginning at a distance of about 200 to 600 parsecs. The predominance of late type dwarfs over giants of the same spectral class seems to be greater than that usually adopted for the nearer regions of space, and the mixture of giant stars apparently varies with distance, the A-type stars showing an increase with corresponding relative decrease of the gK-type stars. Mr. Maxwell's provisional luminosity curve, derived from stars of all types between 125 and 200 parsecs distance shows not only a systematically higher density but also an increase of frequency with absolute magnitude, which for the intrinsically faint stars is more rapid than that given by other investigators. Accepting this frequency of dwarf stars, he shows that the total number of faint stars could be accounted for without exceeding dimensions of the order of 10,000 parsecs.

As an example of "newspaper science," it may be noted, that this final result was exploited in the press under the caption "Lick Scientist Measures the Universe," though Mr. Maxwell had specifically stated that "such limited observations are incompetent to make possible a decision on the problem of the structure of the galactic system."

After receiving the Ph.D. degree in May, 1927, Dr. Maxwell accepted an appointment as instructor in astronomy in the University of Michigan.

Mr. N. Wyman Storer, Lick Observatory Fellow, assisted Dr. Stebbins in his photometric measures of the satellites of Jupiter and later made a photometric study of δ Orionis, securing observations on 57 nights. These measures showed peculiarities in the light curve which could not be interpreted on the basis of the available data, and the in-

vestigation is therefore not yet complete. Many minor improvements in the accessories to the 12-inch telescope were made in the course of this work. Later Mr. Storer began a study of the absolute energy distribution in the continuous spectra of giant and dwarf stars of the same spectral type. The program, which will involve securing low dispersion spectrograms of about 100 stars with the Crossley reflector, and analysis of the plates with the Moll microphotometer, will be completed early in the year 1927-28.

Mr. L. A. Brigham, Lick Observatory Fellow, was in residence at Berkeley during the academic year. The vacation periods were spent at Mount Hamilton in work with the spectrographs and in preliminary investigations on the problem chosen for his thesis.

Through the generosity of Dr. Ambrose Swasey, the Observatory acquired a Moll registering microphotometer early in the year. The great value of this addition to our equipment hardly needs to be emphasized. Several of the researches referred to above have been made possible by its use, and other researches involving its use are in progress.

Eleven *Lick Observatory Bulletins*, totalling 125 quarto pages, were published during the year, and many articles by members of the staff appeared in the *Publications of the Astronomical Society of the Pacific* and other periodicals.

A number of improvements to the buildings and grounds of the Observatory were made in the course of the year, the chief one being the erection of a building to serve as a community center and as a schoolhouse.

R. G. Aitken, *Associate Director.*

LOWELL OBSERVATORY

Flagstaff, Arizona

In the death of Mr. Guy Lowell, on February 4, 1927, the Lowell Observatory suffered the loss of its first trustee at a time when his plans had begun to yield him the desired opportunity to devote his versatile mind considerably to astronomical pursuits.

Mr. Roger Lowell Putnam, nephew of Dr. Percival Lowell, succeeded to the trusteeship. He promptly acquainted himself intimately with the Observatory and its program, and his keen interest and ability are advancing materially its progress.

Mr. A. L. Bennett joined the Observatory staff the first of September, 1926.

The study of the planets has been continued for the period of this report by both visual and photographic observation as in previous years. Except for Mars and Mercury, of which numerous drawings were made, the planets have been observed chiefly by large scale photographs.

Some improvements to the photographic method have been added to give as complete and informative record of the planets as possible. For securing color-filter photographs of the planets from light of widely separated regions of the spectrum with the 24-inch refractor two cameras have been in use, one adapted for photographing in yellow or red light, while the other is arranged to secure, in combination with the spectrographic correcting lens of the large refractor, blue or violet photographs. By these means two almost simultaneous series of red and violet photographs have been secured for Saturn, Jupiter, and Mars. As heretofore, Mars was observed quite regularly at the 1926 opposition. Photographs in at least two colors were made from June to January, about 300 negatives being obtained, while in addition about 225 complete drawings were made from visual observations extending over an even longer period. The extensive series of color-filter photographs of Mars are especially interesting in displaying changes in his atmosphere and on his surface from seasonal influences re-affirming results secured here at earlier oppositions. Jupiter and Saturn were photographed frequently throughout a period of several months, both in blue and in yellow or red light, while Mercury and Venus were less observed. In all some 500 negatives have been secured. Important differences occur between long and short wave photographs of Saturn, Jupiter, and Mars, and from changes on the planets themselves, but it is obviously impossible to summarize the results in brief form. Some results have been published in *Publications of the Astronomical Society of the Pacific* and elsewhere. Observations are being continued on those planets available.

The usual program of spectrographic work has been continued during the year. This included spectra of the planets, selected stars, nebulae, star clusters, comets, the aurora, and the integrated light of selected areas of the sky. In addition to the regular work at the main Observatory, spectrograms of the less refrangible regions of the spectrum were also made chiefly of Jupiter and Mars, in the autumn, at the new high altitude station.

During the year an observing station was established on the San Francisco Peaks, nine miles north of Flagstaff, at an altitude of 11,500 feet. The station is equipped with a 15-inch aperture Petitdidier reflector, equatorially mounted. The shelter and supports of the mounting, although quite serviceable, were done in a temporary manner since it might later seem desirable to place the station still higher as the Peaks rise more than a thousand feet higher. By means of the station the Observatory secures the exceptional advantages of this great altitude in conducting those investigations, in the extreme ends of the spectrum, for which reduction of the terrestrial atmospheric absorption is of essential importance.

Radiometric observations have occupied a considerable part of the time of the 42-inch reflector but some work has also been done in direct

photography, on the continuation of the series of systematic observations of nebulae, and a limited number of photographs and some visual observations of the planets have been made chiefly as checks in their bearing on similar extended planetary investigations carried on with the 24-inch refractor.

Extended series of radiometric measures are in progress on Mercury, Venus, the Moon, Mars, and Jupiter. The sun and several stars have also been observed from time to time, the data sought having an intimate bearing on the planetary radiometry.

In October and November, 1926, for several weeks near the opposition of Mars, Dr. Coblentz of the National Bureau of Standards at Washington again collaborated with Lampland in the radiometric investigations on the planet. Their joint work has been published in the *Scientific Papers* of the Bureau. The longer series of measures by Lampland, who has been assisted in radiometric observations by Mrs. Lampland, awaits publication.

The radiometric equipment of the Observatory has been considerably augmented by new pieces of apparatus from time to time, in galvanometers, vacuum cells, radiometer mountings, transmission screens, and minor parts. A radiometer of a special type has been constructed and used in measurements on the moon. Much experimental work has been done on sensitive thermocouples. Experiments and observations in the laboratory and field, in connection with the radiometric investigations, are in progress.

Professor W. A. Cogshall, Director of Kirkwood Observatory, spent July, August, and a part of September at Flagstaff where he secured an excellent series of photographs of the Milky Way, using his 5-inch aperture Cooke camera on the Lowell 12-inch reflector.

During the year the Observatory instrument shop has installed a new powerful driving clock for the 24-inch refractor. It is a duplicate of the one made for the 42-inch reflector and gives excellent driving. Besides repairs and modifications of instruments the shop has done pieces of radiometric apparatus and equipment for the mountain station.

V. M. Slipher, *Director.*

DETROIT OBSERVATORY

University of Michigan

Ann Arbor, Michigan

Instruction. The usual courses, expanded in some cases by increased laboratory requirements, were given. O. L. Dustheimer and Dean B. McLaughlin completed their work for the Doctor's Degree; Miss Alberta M. Hawes, Miss Laura E. Hill, Miss Frances L. Seydel, and Herbert F. Schiefer were actively engaged in work on their theses

for the same degree, while Morris K. Jessup and Henry F. Donner, having secured their Master's degrees, applied for admission to candidacy for the doctorate.

Space has been occupied in the new building of the College of Literature, Science, and the Arts for a teaching laboratory. Two 24-foot domes by Fecker have been erected on the top of this building. A 10-inch refracting telescope by Warner & Swasey, equipped with a McDowell objective presented by Mr. R. P. Lamont, is mounted in one of these domes. A 4½-inch portable refractor is being used in the other, pending the completion, in the shop, of a 15-inch reflector. Two transit instruments and a horizontal solar telescope will eventually be added to this equipment.

Research. Observations with the single-prism spectrograph attached to the 37½-inch reflector were continued until spring when the program was interrupted to permit the installation of a new two-prism stellar spectrograph. This new instrument was designed by Mr. Curtiss and constructed in the Observatory shop. It is provided with Ross and Hastings camera lenses, giving twice the dispersion of the one-prism instrument, and a Moffitt quad of 12-inch focus, giving a dispersion nearly identical with that employed at this Observatory in its researches of the last sixteen years.

The principal observing program related to stars of Class B, with emission line spectra, north of —20° declination. Intensive observations have been continued on a number of ϕ Persei spectrum variables. A second program included the observation of twenty intrinsically brighter stars of Classes F0 to K0, to study changes in wave-length with spectral class over the spectral range of the brighter Cepheids. This is being done to aid in the interpretation of wave-length variations synchronous with the light changes of Cepheid variables.

Studies of velocity curves with especial attention to irregularities due to rotational velocities during partial eclipse have been continued in the cases of Algol, λ Tauri, and δ Librae.

Spectral studies of ϕ Persei, δ Cephei, HR 985, b_2 Cygni, κ Draconis, χ Ophiuchi, ν Cygni, ν Sagittarii, ζ Tauri, γ Lyrae, β Lyrae, and other objects were also carried on during the year. Papers on ϕ Persei and Algol stars were completed during the year.

Those engaged in the spectroscopic work were R. H. Curtiss, W. C. Rufus, R. A. Rossiter, O. L. Dustheimer, Alberta M. Hawes, Laura E. Hill, Hazel M. Losh, H. F. Balmer, H. F. Schiefer, M. K. Jessup, H. F. Donner, S. W. Taylor, Frances L. Seydel, Mrs. R. H. Curtiss, L. C. Davidson, and Florence Anderson.

Staff. The death of Professor William Joseph Hussey, Director of the Observatory, was recorded in the last of these reports. Professor Ralph Hamilton Curtiss was formally appointed director to succeed

Professor Hussey in March. Professor Rossiter, promoted to the rank of Associate Professor, continued to Bloemfontein, in immediate charge of the Lamont Expedition. Professor Rufus was on leave of absence during the academic year, a member of the faculty of the Floating University. Messrs. Schiefer, Balmer, and Jessup with the Director made up the teaching staff. In addition Mr. Donner served as Lamont Assistant. Dr. Dean B. McLaughlin, Dr. Allan D. Maxwell, and Dr. Hazel M. Losh were added to the staff. Mr. Jessup and Mr. Donner were appointed to the staff of the Lamont Expedition. During the summer session Professor O. L. Dustheimer of Baldwin-Wallace College gave instruction and participated in the research program.

The Southern Expedition. The plant of the Lamont Astronomical Expedition in South Africa has been given the name, "The University of Michigan Southern Observatory." The site selected is on the northern section of the flat summit of Naval Hill within the city limits of Bloemfontein. The building in addition to the central section to support the 56-foot dome and house the 27-inch Lamont Refractor consists of two wings, one containing offices, dark room, and library, the other storage and garage space and rooms for a caretaker. This building is nearing completion. The dome is on the high seas approaching its destination in Africa. The telescope has been stored in Africa ready to be erected when the dome is in place. The two additional members of the southern staff sailed on October 1. With the foundations so solidly laid, it is anticipated that a period of highly productive research in the southern skies, principally on double stars, is in store for us during the coming eight or more years.

R. H. Curtiss, *Director.*

MOUNT WILSON OBSERVATORY

Carnegie Institution of Washington

Pasadena, California

The state of high solar activity which is now near its probable maximum has been utilized throughout the year in a wide variety of observations of sun-spot forms and changes, prominences, sun-spot spectra, the character of motions near sun-spots, and the relationship of terrestrial magnetism to solar activity. The spectrohelioscope as improved and developed by Hale has been used most successfully by him in studying the motions of dark and bright hydrogen flocculi over the sun's surface, and his measurements of the flow of hydrogen in the vicinity of sun-spot vortices have afforded new evidence in support of his previous conclusions that the law of gyratory storms in the solar atmosphere is the same as the terrestrial law of cyclonic storms.

The completion by St. John and his assistants of the list of wave-lengths for the revision of Rowland's Table of Solar Spectrum Wave-lengths and the preparation of over one-half of the tabular material indicate the progress made in this important contribution to astrophysical research. Even in its partially completed form, it has been used extensively for stellar investigations of wave-length, and by visiting astronomers for studies of the flash spectrum. The extension of the table through Babcock's measurements of over 500 lines in the near infra-red with the interferometer adds material especially important for the study of sun-spot spectra and the identification of unrecognized lines of the different elements. The measurements of the oxygen bands in this region of the spectrum have been utilized by Dr. Dieke and Babcock in an analysis of their structure and a determination of the constants involved.

The investigation by St. John of solar wave-lengths has resulted in the accumulation of strong evidence for the existence of the displacements of lines as predicted from the generalized theory of relativity. Lines at the center of the sun produced at an elevation of about 500 km show the theoretical displacement, while those at a higher level show more, and those at a lower level less. The existence of descending currents at high levels in the atmospheres of sun and stars and of ascending currents at low levels would account for the observed differences. At the edge of the sun, where the effect of the radial currents would disappear, the displacements are nearly of the predicted amount.

Measurements of the ultra-violet radiation of the sun have been continued regularly by Pettit with results which show a considerable degree of correlation with sun-spot numbers and the solar constant. Comparisons of the atmospheric transmission of ultra-violet radiation of wave-length 0.32μ, at elevations ranging from near sea-level to 3.5 km, indicate an agreement with theoretical values at an altitude of 1.83 km, with a greater transmission at higher altitudes, and much less at lower altitudes than theory would predict.

Observations of the polarities of sun-spots by Nicholson, Ellerman, and L. H. Humason show that in a total of 306 spots only 8, or less than 3 per cent, are exceptions to the rule of the reversal of polarity occurring at the sun-spot minimum of 1923. The whole number of groups of spots observed on the sun during the year was 373, 74 more than in 1925, nearly the entire increase being in the southern hemisphere.

Other solar investigations of the year have included a comparison by Pettit and Nicholson of the values of the radiation of the corona, as deduced from the theory of scattering by an atmosphere of free electrons, with their results obtained at the eclipse of January, 1925; comparisons by Nicholson of solar disturbances and terrestrial magnetic storms as observed on Mount Wilson; studies of sun-spot spectra in

the near infra-red; and observations by Ellerman of the motions of granulations on the sun's surface.

In the field of planetary photography the results obtained by Dr. Ross of the Yerkes Observatory by photographing Venus in ultra-violet light are of special interest. His observations show a remarkable amount of detail, in the nature of rapidly changing dark belts parallel to the equator and bright areas near the poles, which is not seen on photographs taken in yellow or red light. Similar observations of Jupiter and Saturn have been made by Ross and Pease.

The radiation from the dark side of the moon has been measured by Pettit and Nicholson and is found to indicate a temperature of 110° C absolute. The same observers measured the rate of cooling of a point on the lunar surface at the total eclipse of June 14-15, 1927. Before eclipse its temperature was 350° C absolute; while passing through the penumbra the temperature dropped rapidly, reaching 170° C at the beginning of totality. During the total phase there was a gradual drop to 150° C absolute. Spectroscopic observations of the same eclipse by Adams and Joy give little indication of the appearance of new bands or lines in the spectrum near the edge of the earth's shadow.

Nicholson and Miss Losh have calculated an ephemeris for the Ninth Satellite of Jupiter for the 1927 opposition, and Nicholson secured a satisfactory series of observations during the opposition of the previous year.

A study of the distribution of extra-galactic nebulae in the vicinity of the Milky Way is being undertaken by Hubble for the purpose of defining more closely the limits within which they occur. So far nebulae have been found within 10°, but not within 5° of the plane. Hubble is also continuing his investigation of the luminosity of extra-galactic nebulae, studying the magnitudes of the brightest stars involved and also the frequency-functions of the luminosities of the nebulae in nebular clusters. The results obtained favor the view that statistically the nebulae can be treated as intrinsically equally luminous.

About 50 variable stars, 36 of which are Cepheids, and 75 novae have been observed by Hubble in the study of the Andromeda nebula which he is completing. A combination of the results of these Cepheids with those of Messier 33 establishes a good period-luminosity curve for periods between 10 and 70 days. At the distance for the nebula indicated by the Cepheids, the mean absolute magnitude of the novae at maximum light is —5.2.

Observations by Hubble and Dr. Duncan of the disk nebulosity around Nova Aquilae No. 3, 1918, show that the disk has been expanding uniformly at a rate of about 2″ annually since the outburst of the star. When combined with the early radial-velocity measures, this leads to a parallax of ±0″.0028. The spectrum shows a transition toward that of Wolf-Rayet stars.

Spectrograms of the Andromeda nebula and its companion N.G.C. 221 obtained by M. L. Humason with the Cassegrain spectrograph show a solar-type spectrum with dwarf characteristics. The radial velocities are considerably less than those obtained from photographs with lower dispersion.

An interesting discovery by van Maanen is that of the third nearest star, Wolf 359, with the faintest absolute magnitude known. Its parallax is 0".40, its absolute photographic magnitude 18.5, and its spectrum, as derived from a photograph by Humason, M6e. Van Maanen has continued his photographic measurements of double stars, and has completed his results for three globular star clusters. These show that no internal motions exceeding 0".002 annually can be present. The proper motions are extremely small.

From the continuation of his studies of stellar distribution Seares finds a progression in the longitude of the center of the galactic system and the position of its plane which begins with the brighter stars and continues to the faintest stars observed. As a result, the distance of the sun from the center of the system defined by stars brighter than the eighteenth magnitude may be considerably greater than hitherto supposed. An important conclusion is that the local cluster of stars includes the great majority of the brighter stars and that its influence is predominant in determining the space density near the sun. The effect of this local cluster can be traced to stars of the fifteenth magnitude, and its radius, therefore, is probably of the order of 3000 parsecs instead of about 500 parsecs as determined from the bright helium stars.

The determination of the center of the galactic system is rendered difficult on the one hand, by the masking effect of the local cluster, and, on the other, by the smoothing out effects inherent in surface counts of stars due to the enormous range in stellar luminosity. The contours of equal density even for small densities are not concentric, and so cannot be used as a criterion for fixing the geometrical center. The contours of constant density for the larger system, as distinguished from the local cluster, uncertain as they are, indicate a much larger distance than has generally been supposed.

In the department of stellar spectroscopy the application of a 15-foot spectrograph to investigations of some of the brighter stars has led to the identification of additional elements of the rare-earth group in the spectra of stars of type similar to the Cepheid variables, and has provided further evidence of systematic displacements for different groups of lines. Determinations of the intensities of the lines on these spectrograms afford rich material for investigations of stellar temperatures and pressures.

Among the interesting results of the radial-velocity observations reference may be made to the high velocities found for three Cepheid variables, one of which, TX Ophiuchi, has a velocity of —160 km/sec;

to the orbits of the dwarf star Boss 5683 and the Cepheid variable T Monocerotis determined by Sanford, the eclipsing variable S Antliae by Joy, and the B2e spectroscopic binary H.D. 163181 by M. L. Humason and Nicholson. The last-named star is one of the most massive stars known.

Studies have been made by Joy of the important variable stars o Ceti, W Serpentis, and U Sagittae with interesting results for their radial velocities and spectral changes. Merrill has investigated the relationship of spectra of types S and M and concludes that their temperatures overlap, but that the S-type stars are of lower density. Merrill has also made a search for stars of lower temperature than the long-period variables, has continued his observations of changes in the spectrum of the interesting star R Aquarii, and has made a classification of stars with bright iron lines. Merrill, Humason, and Miss Burwell have discovered 15 new stars of types Be and O during the year.

An investigation by Adams and Joy shows that the relationship between spectral type and logarithm of length of period among the Cepheid variables is essentially linear, the spectral type becoming later, the longer the period. The cluster-type variables show a considerable range in spectrum with little change in period. Dr. Russell finds from these results for the Cepheids that the observed change is in close agreement with that which should occur in a group of stars undergoing similar dynamical oscillations and subject to the period-luminosity relationship.

The completion of the study of the absolute magnitudes of the M-type stars by Adams, Joy, and Humason, the commencement of a similar investigation for stars of type K5, and the determinations of the luminosities of many stars of earlier type represent the chief applications of the spectroscopic method for deriving absolute magnitudes. In connection with these investigations Strömberg has worked out formulae for computing the dispersion in absolute magnitude and the probable errors for any group of stars in which the absolute magnitudes may be assumed to be distributed according to a normal error function.

Strömberg has studied the space-velocities of the giant M-type stars, using the spectroscopic absolute magnitudes, and finds that their distribution can be represented by an error curve without skewness or excess. The preferential motion is pronounced, but no trace of Kapteyn's two streams can be found. The distribution function around the axis of asymmetry is found to be of the same form as that for cosmical objects in general.

Measurements of stellar radiation have been continued by Pettit and Nicholson with thermocouples of increased sensitiveness. Ten long-period variables observed over more than four periods show a mean absolute bolometric magnitude of —4 at maximum of light. The observations of 154 stars made between 1922 and 1927 have been reduced

to a homogeneous system of radiometric magnitudes, and the heat indices have been derived for the successive spectral types of giant stars from A0 to M8.

The diameter of α Orionis as measured by Pease with the 20-foot interferometer shows an increase from the values for the previous year, the fringes disappearing at mirror separations of between 11 and 12 feet as compared with 14 feet found in the autumn of 1925. Pease has also secured measurements of the separation and position angles of the components of the spectroscopic binary Mizar, which are in excellent agreement with computed values.

In the physical laboratory King has made extensive investigations of the spectra of the rare earths. About 1600 lines of neutral cerium have been measured between λ 3000 and λ 4700, few of which have been measured previously. With the aid of Miss Moore most of the ionized lines of cerium, neodymium, and samarium have been identified with lines present in the solar spectrum.

King has utilized photographs of the spectra of iron, chromium, manganese, nickel, and cobalt, taken with the 1000-ampere arc in air, for further classifications of the lines with respect to widening, and has also used the high-current arc in vacuum to group the ionized lines in the ultra-violet region of iron into multiplets.

The spark spectra of several elements in vacuum have been studied by Anderson with the use of the large condenser. An examination of the spectrum of multiply-ionized lines indicates that the higher stages of ionization are favoed by the use of a smaller condenser with which higher frequency can be secured. Anderson is planning a continuation of the study of the Stark effect for metals, using the condenser as a source of high voltage direct current.

Values of the pressure displacements of iron lines determined by Babcock have been expressed by him on a scale of frequencies and studied with the aid of a list of term-values. He has thus found it possible to describe the pressure effect as a differential depression of the term-values whose differences correspond to the wave-numbers of the individual lines. In this way a quantitative relationship is derived which permits of the calculation of the pressure effect for many lines for which it is not yet known.

A most extensive and complete analysis of the spectrum of titanium has been completed by Dr. Russell. In the spectrum of the normal atom 1395 lines have been classified, and 522 in the singly, 90 in the doubly, and 31 in the trebly ionized atom. Series have been found in each of these spectra and the ionization potentials determined. The investigation cannot fail to prove of great value to students of astrophysics and atomic theory.

Through the identification on theoretical considerations of the lines which correspond to the same types of transition within the atoms, Dr.

Russell has been able to recognize in the elements of the iron group sequences of lines strikingly similar in physical characteristics and of great interest astrophysically. In the course of this work he has found for the first time series in the arc spectrum of vanadium and the spark spectrum of manganese. This has made it possible to derive ionization potentials for the normal and in most cases for the ionized atom of all the elements of this group. In the few remaining cases fairly good values for the ionized atom have been derived through the application of Moseley's law.

Numerous other investigations have been carried on in the physical laboratory, including a study by Smith of the intensities of the Balmer lines of hydrogen under different conditions of excitation; tests of the accuracy of the registering microphotometer; an examination of the spectral transmission of various types of filters; and measurements of the reflecting power of certain metals and alloys by Pettit; a study by Anderson of Ronchi's method of testing optical surfaces; and the design by Smith of a new type of vertical seismometer.

Dr. Michelson has completed additional measurements of the velocity of light between Mount Wilson and Mount San Antonio, a distance of 35385.53 meters, according to the determination of the U. S. Coast and Geodetic Survey. The final result obtained from a series of very accordant measures with five different rotating mirrors of 8, 12, and 16 faces is 299797 kilometers per second *in vacuo*. Further attempts will be made in the autumn to measure the velocity of light between Mount Wilson and Mount San Jacinto.

A repetition of the Michelson-Morley experiment on the ether-drift has been begun by Dr. Michelson with an 11-foot interferometer. Provisional measures show but very small displacemnts of the interference fringes.

W. S. ADAMS, *Director.*

(To be continued.)

HEAVENLY ZOO.

Bears.

An ursine mother and her son
Are these; a big and little one;
That dwell forever in the sky.
The Dippers are their astral jail;
The north star is young bruin's tail;
A goddess chased them up so high.

Dolphin.

This porpoise favored art for he
Rescued a poet from the sea
And brought Arion safe to shore.
A place in heaven was decreed
To him in payment for the deed:
He hears the stars sing evermore.

1490 Stuart St., Denver, Colorado. LILLIAN WHITE SPENCER.

PHENOMENA FOR 1928.

By HAROLD F. BALMER.

ECLIPSES.

During 1928 there will be five eclipses, three of the sun and two of the moon. The following information concerning them, including Figures 1 and 2, is obtained from the *American Ephemeris*:

TOTAL ECLIPSE OF MAY 19, 1928

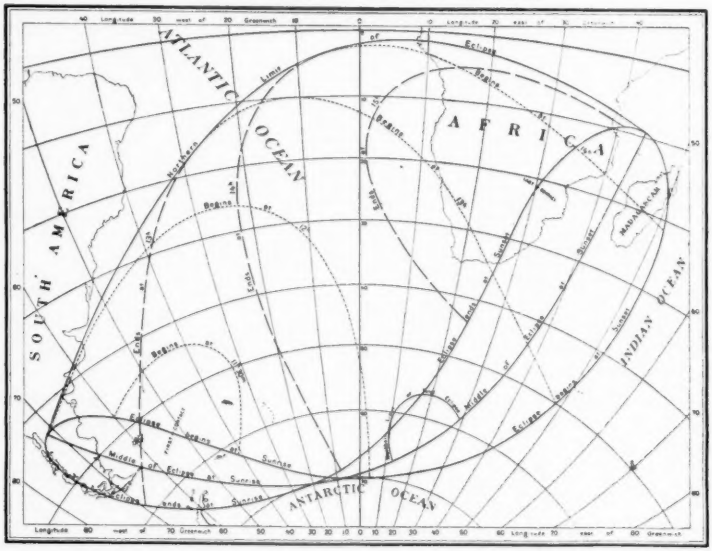


FIGURE 1.

1. On May 19 there will be a total eclipse of the sun of which the circumstances are as follows:

	Greenwich Civil Time	Longitude from Greenwich	Latitude
	d h m	° ′	° ′
Eclipse begins	May 19 11 25.4	+52 17	−54 17
Total eclipse begins	19 13 11.9	−12 18	−67 11
Greatest eclipse	19 13 24.0	−22 25	−63 17
Total eclipse ends	19 13 36.2	−29 14	−58 24
Eclipse ends	19 15 22.6	−30 20	−21 23

The accompanying map, Figure 1, shows the regions in which the eclipse will be visible.

2. On June 3 there will be a total eclipse of the moon, the beginning visible

generally in the western part of South America, the western part of North America, the Pacific Ocean, Australia, and the eastern border of Asia; the ending visible generally in the Pacific Ocean, Australia, and the eastern part of Asia. The circumstances of the eclipse are as follows:

	Greenwich Civil Time d h m
Moon enters penumbra	June 3 9 5.2
Moon enters umbra	3 10 17.6
Total eclipse begins	3 11 31.3
Middle of eclipse	3 12 9.4
Total eclipse ends	3 12 47.6
Moon leaves umbra	3 14 1.6
Moon leaves penumbra	3 15 14.5

Magnitude of the eclipse = 1.247 (Moon's diameter = 1.0).

3. On June 17 there will be a partial eclipse of the sun of which the circumstances are as follows:

	Greenwich Civil Time d h m	Longitude from Greenwich ° ′	Latitude ° ′
Eclipse begins	June 17 20 1.6	—95 52	+61 51
Greatest eclipse	17 20 27.0	—70 33	+65 39
Eclipse ends	17 20 52.3	—41 42	+66 31

Magnitude of greatest eclipse = 0.037 (Sun's diameter = 1.0).

PARTIAL ECLIPSE OF NOVEMBER 12, 1928

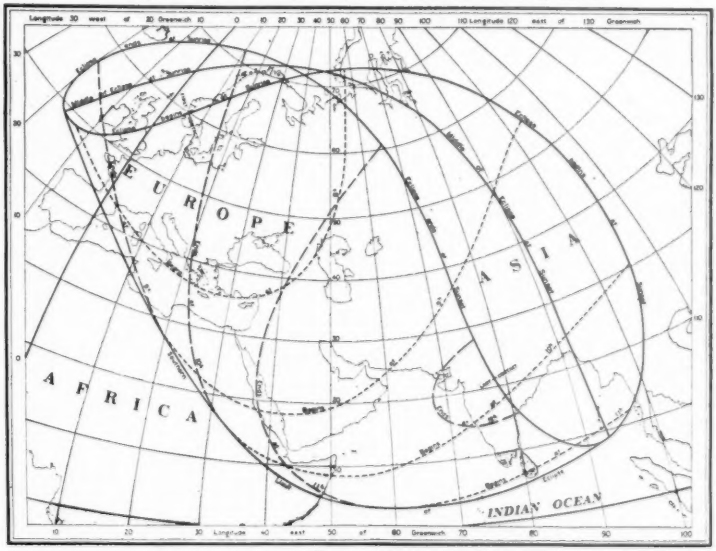


FIGURE 2.

4. On November 12 there will be a partial eclipse of the sun of which the circumstances are as follows:

	Greenwich Civil Time	Longitude from Greenwich	Latitude
	d h m	° ′	° ′
Eclipse begins	Nov. 12 7 33.3	— 6 4	+59 54
Greatest eclipse	12 9 47.9	—80 59	+62 40
Eclipse ends	12 12 2.8	—78 9	+21 25

Magnitude of greatest eclipse = 0.808 (Sun's diameter = 1.0).

The accompanying map, Figure 2, shows the regions in which the eclipse will be visible.

5. On November 27 there will be a total eclipse of the moon, the beginning visible generally in the western and northern borders of Europe, the Atlantic Ocean, North America, South America, the Pacific Ocean, and the northern part of Asia; the ending visible generally in North America, the northern part of South America, the Pacific Ocean, Australia, and the eastern part of Asia. The circumstances of the eclipse are as follows:

	Greenwich Civil Time
	d h m
Moon enters penumbra	Nov. 27 6 25.4
Moon enters umbra	27 7 23.8
Total eclipse begins	27 8 33.1
Middle of eclipse	27 9 1.2
Total eclipse ends	27 9 29.3
Moon leaves umbra	27 10 39.0
Moon leaves penumbra	27 11 37.8

Magnitude of the eclipse = 1.155 (Moon's diameter = 1.0).

The Sun.

On March 20 at $20^h\,45^m$ the sun enters Aries and spring commences; on June 21 at $16^h\,7^m$ the sun enters Cancer and summer commences; on September 23 at $7^h\,6^m$ the sun enters Libra and autumn commences; and on December 22 at $2^h\,4^m$ the sun enters Capricornus and winter commences. Note that the times given here and elsewhere in this article, like those used in the circumstances of the eclipses, are given in Greenwich Civil Time. To obtain Central Standard Time six hours must be subtracted.

The year 1928 is quite close to the time of maximum sunspot activity and should afford an excellent opportunity for the study of these features of the sun's surface.

The Planets.

Mercury at the beginning of the year is in Sagittarius. During the year its motion, which is eastward except for the periods from February 15 to March 7, June 16 to July 10, and Oct. 12 to Nov. 1, during which it is retrograde, carries it through a little more than one complete circuit of the sky.

Owing to its nearness to the sun the planet is seen only near the times of its greatest elongation from the sun and then only for a period of about two weeks. At the time of greatest eastern elongation the planet is seen as an evening star, setting after the sun, and at the time of greatest western elongation it is seen as a morning star above the eastern horizon before sunrise. The most favorable eastern elongations are those which occur in the spring, and the most favorable western elongations are those which occur in the atumn, for at these times the altitude of the planet at sunrise or sunset will be greatest for a given separation

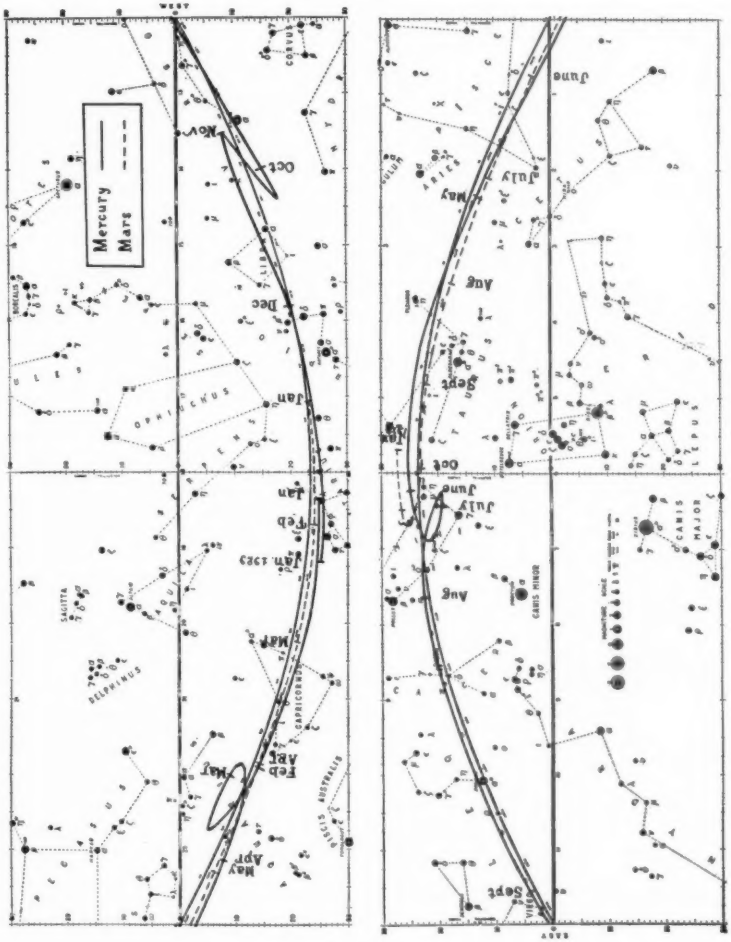


FIGURE 3.

APPARENT PATHS OF THE PLANETS MERCURY AND MARS AMONG THE STARS DURING THE YEAR 1928.

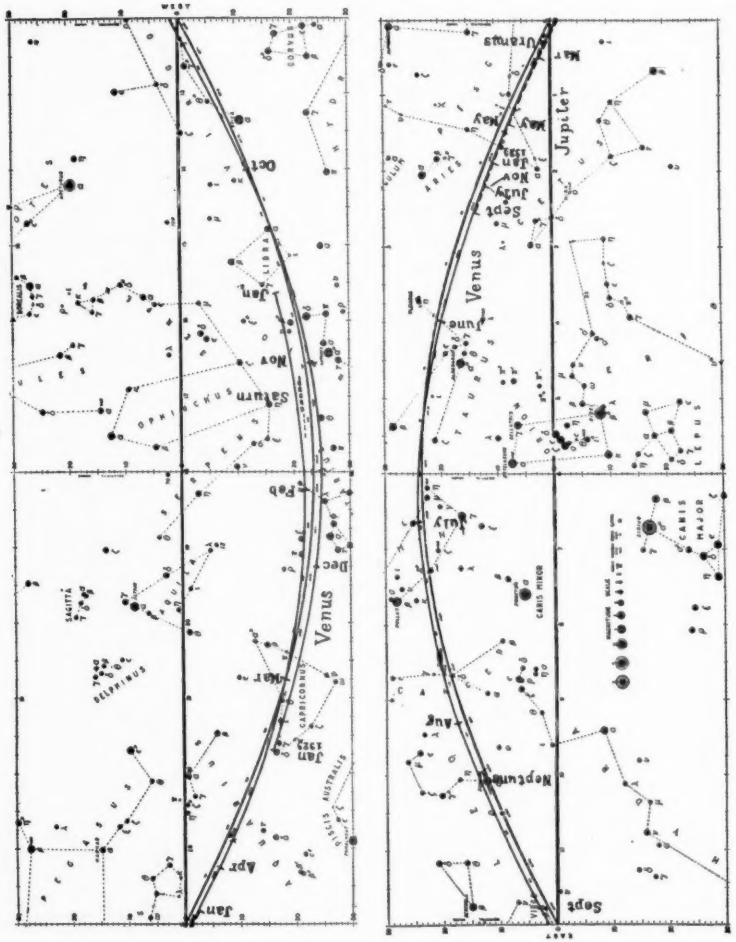


FIGURE 4.

APPARENT PATHS OF THE PLANETS VENUS, JUPITER, SATURN, URANUS, AND NEPTUNE AMONG THE STARS DURING THE YEAR 1928.

(The background of Figures 3 and 4 is a part of Chart SC1, copyrighted, 1925, and published by the Eastern Science Supply Co. It is used here by courtesy of this company.)

from the sun. The dates of greatest elongation and the angular distances from the sun at these times are as follows:

	Greenwich Civil Time		Separation		
	d	h	°	′	
Feb.	9	3	18	12	E.
Mar.	22	15	27	46	W.
June	3	1	23	32	E.
July	21	4	20	11	W.
Sept.	30	4	25	52	E.
Nov.	9	7	19	4	W.

Venus at the beginning of the year is in the constellation Libra and is seen as a fine morning star at a distance of about forty degrees from the sun. At this time it is moving away from the earth with diminishing brightness and its separation from the sun is decreasing. This continues until the planet reaches superior conjunction with the sun on July 1 at 15^h, after which it is an evening star, increasing in brightness and becoming more and more favorably placed for observation until the end of the year when it is in Capricornus about forty degrees east of the sun. During the year the planet does not attain its greatest brilliancy, its greatest elongation from the sun, nor does it have a period of retrograde motion.

Mars begins the year in Ophiuchus, about ten degrees to the east and a little to the north of Antares and is of the same reddish color but fainter. It moves steadily eastward, increasing in brightness and elongation from the sun, and on November 12 at 10^h it reaches a stationary point in Gemini and begins to retrograde, continuing to do so until the end of the year. On December 21 at 14^h it comes into opposition with the sun and is visible all night.

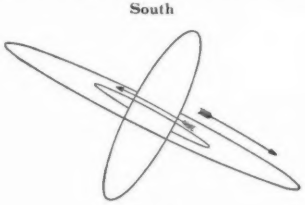


FIGURE 5.

Apparent orbits of the satellites of Mars at date of opposition, December 21, 1928, as seen in an inverting telescope and elongated in the ratio of four to one in the direction of their minor axes.

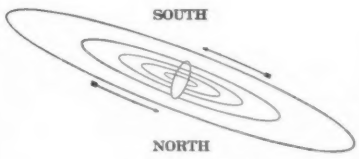


FIGURE 6.

Apparent orbits of the satellites of Jupiter at date of opposition, October 29, 1928, as seen in an inverting telescope, and elongated in the ratio of three to one in the direction of their minor axes.

Jupiter is in Pisces at the beginning of the year. Until August 30 at 17^h, when it reaches a stationary point in Aries, it moves slowly eastward. From this date until December 26 at 10^h its motion is retrograde, after which it resumes its slow eastward motion. Opposition with the sun occurs on October 29 at 0^h. The path of Jupiter is practically coincident with part of the path of Venus, and on April 29 at 8^h these two planets are in conjunction, Venus being twenty-six minutes of arc to the south.

Saturn at the beginning of the year is in Scorpio and moving slowly eastward.

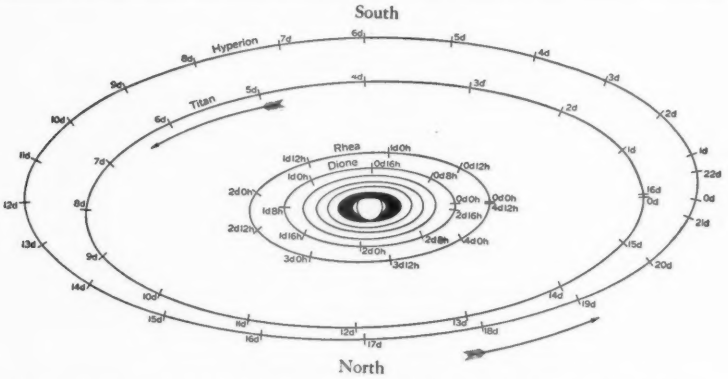


FIGURE 7. Apparent orbits of the seven inner satellites of Saturn, at date of opposition, June 6, 1928, as seen in an inverting telescope.

On March 28 at 23^h it reaches a stationary point after which its motion is retrograde until August 17 at 7^h, when another stationary point is reached. From then its motion is again eastward until the end of the year when the planet will be in Ophiuchus. Opposition with the sun occurs on June 6 at 20^h.

Uranus during 1928 is in Pisces. Its motion is direct until July 13 at 5^h, retrograde from then until December 13 at 9^h, after which it is again direct until the end of the year. Its path among the stars is almost coincident with the paths of Venus and Jupiter and consequently is not prominent on the chart. Conjunction with the sun occurs on March 24 at 6^h, quadrature on June 29 at 8^h and on December 25 at 13^h, and opposition on September 28 at 19^h.

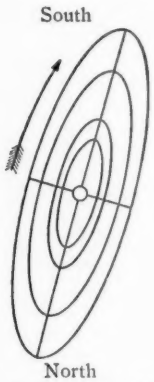


FIG. 8. Apparent orbits of the satellites of Uranus at date of opposition, September 28, 1928, as seen in an inverting telescope.

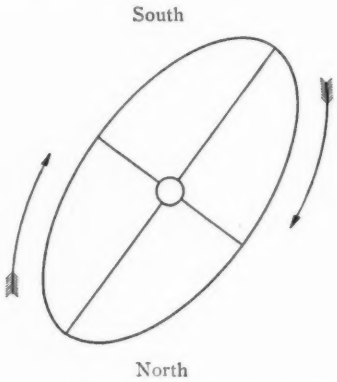


FIGURE 9. Apparent orbit of the satellite of Neptune at date of opposition, February 17, 1928, as seen in an inverting telescope.

Neptune during 1928 is in Leo and is never more than about three degrees from the bright star Regulus. Its motion is eastward until May 7 at 15^h, retrograde from then until December 4 at 6^h, after which it is again eastward until the end of the year. Conjunction with the sun occurs on August 22 at 7^h, quadrature on May 17 at 15^h and on November 23 at 21^h, and opposition on February 17 at 17^h.

Figures 3 and 4 show the paths of the planets among the stars during the year. (The background of these drawings is copied from Chart SC1, published during by the Eastern Science Supply Co.) Figures 5 to 9 inclusive, showing the apparent orbits of the satellites, are taken from the *American Ephemeris*.

SATELLITES.

As heretofore we shall publish the configurations of the satellites of Jupiter and Saturn when these planets are in suitable position for observation.

COMETS.

The return of three periodic comets, Encke, Holmes, and Taylor, may be expected in 1928. According to the ephemerides in the *Handbook of the British Astronomical Association* these are due at perihelion on February 19 and in March and October, respectively. Comet Encke was observed by Professor G. Van Biesbroeck on November 13, 1927, and will be in favorable position for northern observers during January.

In addition to these three, comet Skjellerup, which reached perihelion in December, 1927, will be readily visible to the naked eye in the northern hemisphere during the first part of January.

By means of the "Comet Notes" contributed each month by Professor Van Biesbroeck, our readers will be kept in touch with the most recent information which is available concerning comets.

OCCULTATIONS.

During 1928 there will be two occultations of Mars but no occultations of stars brighter than the second magnitude. For the occultations of stars brighter than the fourth magnitude which are visible in the United States we hope to publish charts by Wm. Cletus Doyle, S.J., the successor of Father Rigge at The Creighton University. We shall also give from month to month the occultations visible at Washington as found in the *American Ephemeris*.

METEORS.

This department will continue, as during the past year, to be under the direction of Dr. Charles P. Olivier, president of the American Meteor Society. As Dr. Olivier's office is the central bureau of information concerning meteor observing in this country, we shall happily be in contact with the most authentic source.

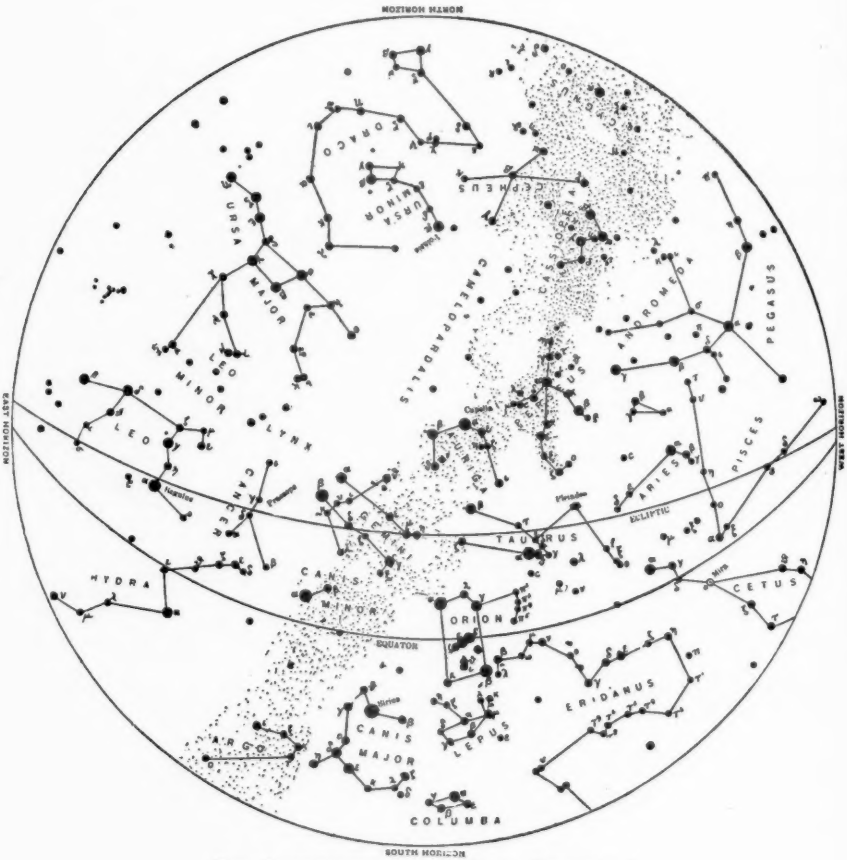
Occultations Visible at Washington.

[From the *American Ephemeris*.]

Date 1928	Star's Name	Magnitude	IMMERSION. Washington C.T.	IMMERSION. Angle from N	EMERSION. Washington C.T.	EMERSION. Angle from N	Duration
			h m	°	h m	°	h m
Feb. 2	52 B.Geminorum	6.5	17 36	70	18 44	269	1 7
3	181 B.Geminorum	6.0	18 7	45	18 56	309	0 49
6	46 Leonis	5.8	21 37	139	22 44	264	1 7
15	24 Ophichi	5.5	6 30	72	7 44	325	1 14
27	224 B. Tauri	6.1	19 17	350	19 29	333	0 12

PLANET NOTES FOR FEBRUARY.

By CLIFFORD E. SMITH.



THE CONSTELLATIONS AT 9:00 P.M. FEBRUARY 1.

The *Sun* will be moving northeast from the central part of Capricornus to the central part of Aquarius. The position of the sun for February 1 and February 29, respectively, will be:

R.A. $20^h\ 53^m$, Decl. $-17°\ 30'$; R.A. $22^h\ 43^m$, Decl. $-8°\ 8'$.

The phases of the *Moon* for February will occur as follows:

Full Moon	Feb.	5 at	2 P.M.	C.S.T.
Last Quarter		13 "	1 P.M.	"
New Moon		21 "	4 A.M.	"
First Quarter		27 "	9 P.M.	"

The moon will be at apogee (farthest from the earth) on February 12, and it will be at perigee (nearest the earth) on February 24.

Mercury will be in Aquarius. Its apparent motion during the first half of the month will be eastward, but during the last half its apparent motion will be westward. On February 9 Mercury will be at greatest elongation east, and at that time it will set approximately an hour after the sun. On February 24 Mercury will be at inferior conjunction.

Venus, early in the month, will be in Sagittarius. Late in the month, however, it will cross into Capricornus. On February 14 Venus will be in conjunction with Mars. At that time they will rise about two and a half hours before the sun.

Mars will be moving eastward near Venus. At the end of the month it will be on the border of Capricornus. As has been stated before in the notes on Venus, Mars will be in conjunction with Venus on February 14.

Jupiter will be an evening star in the constellation Pisces. At the end of the month it will set about an hour and a half after the sun.

Saturn will be a morning star in the southern part of Ophiuchus. During the middle of the month it will rise approximately four and a half hours before the sun.

Uranus will be in the evening sky near Jupiter in the constellation Pisces. At the end of the month it will set approximately an hour and a half after the sun.

Neptune will be in Leo near Regulus (α Leonis). On February 17 it will be in opposition, and at that time it will be above the horizon all night in northern latitudes.

The Transit of Mercury at Manila, November 10, 1927.— Though the sun shone brightly three or four minutes before the first contact, clouds appeared just at the crucial moments and no observations at all could be made of first and second contacts, thus disappointing the array of half a dozen eager watchers ready to record the contacts.

The third and fourth contacts were also tantalizingly missed in a similar manner. However, the Repsold Transit was used for determining the passage of the planet across our central meridian. The clouds lifted just in time to obtain the passage across the five cross-hairs following the middle. The passage of the centre of the planet was recorded, the average deviation for the five measures being one-tenth of a second. This is comparatively large, and is due to the fact that the planet was visible only through a thin veil of clouds. The time of meridian passage *observed* was $3^h\,40^m\,41^s.12$ G.M.T. Using the *Connaissance de Temps,* the *calculated* time of passage is $3^h\,40^m\,40^s$ G.M.T.

Using a camera attached to the finder of the large equatorial, some photographs were obtained. The situation was interesting, since Mercury passed close to a large group of sunspots near the centre of the sun. However, due to a veil of clouds, sharp definition was impossible, and the photographs when enlarged, as would be necessary for publication, are rather disappointing.

Observations of Venus in 1924. — In the year 1924 when the planet Venus was near eastern elongation, 100 drawings of the surface details were made at the astronomical observatory of the school in Petrograd. Of these drawings, 29 were made by the writer and 18 by Ludmila Antropova. The instrument used for the observations was the 108 mm apochromat made by A. A. Tchichin. Almost

from the beginning to the end of the observations, namely, from March 21 to June 7, the details of the planet were visible as great white spots, superposed on the darkest part.

The observations were made one each day and, since the details preserved their position, it was supposed that Venus has no rapid rotation. On the other hand, when the observations were made every day at intervals of several hours, then two drawings separated in time by one or two hours gave visible motion of details. By using all the material it was found that the period of the rotation of Venus about the axis is very nearly the same as that of the earth, and that the sidereal day of Venus is approximately 23 hours and 58 minutes.

The results show that observations should be made possibly several times during the day.

N. P. Shanin.

U.S.S.R., Leningrad, 9 Krasnoarmejskaja 13, 9.

VARIABLE STARS.

Nova Tauri 1927.—According to *Harvard Announcement Card* 40, additional photographic observations of this nova, referred to on page 593 of the December issue, have been made by Miss Cannon as follows:

1927	November 23	10.2
	November 29	11.4
	December 1	11.6

Two New Variables in the Region of the Andromeda Nebula.—A fifteenth magnitude star, following the nucleus of the Andromeda Nebula by 9′.2 and south of it by 4′.0 is found to be variable (H.V. 4013). Its estimated magnitude on seven occasions is given below, together with the corresponding Julian Days.

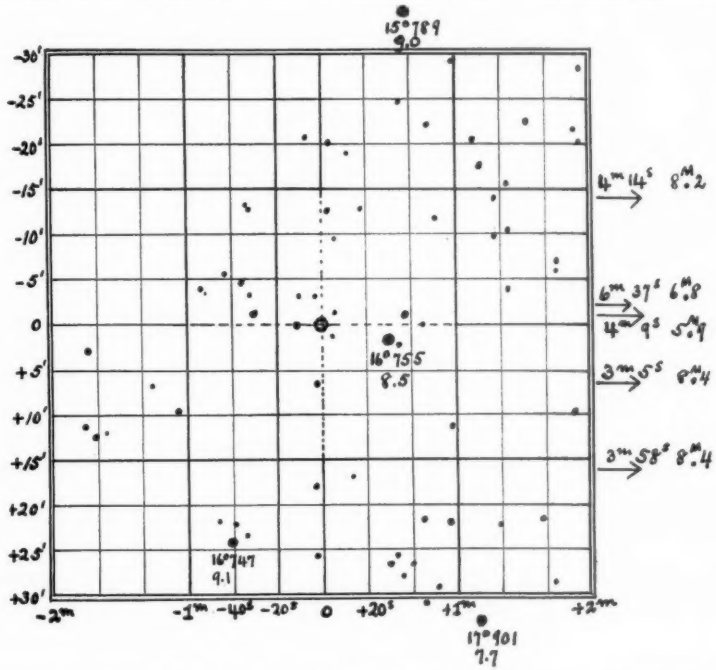
The variable has already been found at Mount Wilson, according to unpublished data kindly communicated by Dr. Hubble, who states that it is the brightest variable in the nebula. From observations made between 1909 and 1927 it appears either that the variable is irregular or that it has a period of several years.

Julian Day	Pg. Mag.
2414223	16.5
23668	15.9
23669	15.9
24766	15.8
24790	15.6
24814	15.7
24844	15.3

Since the star is situated on one of the outlying arms of the spiral, it possibly belongs to the nebula. The peculiarity of its light changes rather strengthens than weakens such a supposition. In this case the absolute photographic magnitude would be of the order of —7.0 at maximum.

Another star, H.V. 4014, situated at $0^h\,29^m\,47^s$, $+41°\,07'.5$ (1900), seems to vary between about $13^M.5$ and $14^M.5$, being faint on but two of the available eight plates, and bright on the remainder. (*Harvard College Observatory Bulletin*, No. 851.)

Star Chart for Schwassmann and Wachmann's Nova*. — The accompanying chart has been prepared as an aid for those who may desire to observe the Nova but have not at hand the necessary charts or catalogues for its identification. The present chart has been copied from the Bordeaux Astrographic Chart $5^h\,12^m$, $+16°$. All the stars above the eleventh photographic magnitude have been included; in the immediate neighborhood of the variable all the stars down to the limit of the chart, which is about the fourteenth magnitude, are shown. The size of the dots indicates only in a rough manner the magnitude of the corresponding stars, the main purpose being to give prominence to those stars which will enable the observer to identify the variable with certainty. The BD stars in the region of the chart are indicated by their catalogue number and



magnitude; those that follow the variable within a few minutes of R.A. are indicated at the margin of the chart, the position of the arrows showing the declination and the attached numerals showing the difference in R.A. between the variable and the BD stars and also the visual magnitudes. The North is at the bottom and the East at the right of the chart so as to represent the aspect of the stars as viewed in an inverting telescope.

EDWARD C. PHILLIPS, S. J.

Georgetown College Observatory, 27 November 1927.

*Received just after the preceding issue was printed. It is included here for the benefit of those whose instrumental equipment will enable them to follow this nova even though it has become rather faint. ED.

Minima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Minima in 1928							
					February							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8			12 18					
RT Sculptor.	31.5	—26 13	9.6—10.5	0 12.3	4 23		12 2		19 6		26	11
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	7 3		14 15				22	3
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	6 10		12 12		18 15		24	18
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	4 18		10 11		21 22		27	15
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	2 19		9 16		16 13		23	10
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	1 1		9 14		15 9		24	23
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	9 12				17 10		25	9
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6					22 15			
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	4 4		12 18		21 8			
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	4 19		10 18		22 15		28	14
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	1 12		9 10		17 7		25	5
RW Tauri	3 57.8	+27 51	7.1— [11	2 18.5	4 6		12 13		20 21			
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	5 16		11 14		23 10		29	8
RW Persei	13.3	+42 04	8.8—11.0	13 04.8	7 23				21 4			
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	1 14		7 21		20 12		26	19
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1			11 18				24	4
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	4 18		10 7		21 8		26	21
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	4 20		10 7		21 4		26	15
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	4 8		10 9		22 10		28	11
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	2 22		9 10		22 10		28	22
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	2 17		13 3		18 8		28	18
SV Gemin.	54.6	+24 28	9.8— [11	4 00.2	3 23		11 23		19 23		27	23
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	3 16		9 10		20 21		26	14
U Columbæ	6 11.2	—33 03	9.2—10.0	2 19.2	6 12		12 17		18 23		25	4
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	4 8		11 4		18 0		24	20
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	7 14		15 5		22 20			
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	6 12				18 17			
RU Monoc.	6 49.4	— 7 28	9.8—10.5	0 21.5	5 12		12 16		19 20		27	0
R Can. Maj.	7 14.9	—16 12	5.8— 6.4	1 03.3	4 2		10 21		17 17		24	12
RY Gemin.	21.7	+15 52	8.9— [10	9 07.2	2 20		12 3		21 10			
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	4 21		11 3		17 18		24	8
TX Gemin.	30.3	+17 08	10.0—11.9	2 19.2	4 1		12 11		20 20		29	6
RR Puppis	43.5	—41 08	9.4—10.7	6 10.3	7 9		13 19		20 6		26	16
V Puppis	7 55.4	—48 58	4.1— 4.8	1 10.9	6 1		13 8		20 15		27	21
X Carinæ	8 29.1	—58 53	7.9— 8.7	0 13.0	5 8		12 9		19 10		26	11
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	4 16		14 3				23	15
RX Hydræ	9 00.8	— 7 52	9.1—10.5	2 06.8			11 19		18 21		28	1
S Velorum	29.4	—44 46	7.8— 9.3	5 22.4	3 20		9 18		21 15		27	13
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	2 20		9 14		23 2		29	20
RR Velorum	10 17.8	—41 36	10.0—10.9	1 20.5	6 7		13 17		21 3		28	13
SS Carinæ	54.2	—61 23	12.2—12.8	3 07.2	4 5		10 19		17 10		24	0
RW Urs. Maj.	10 35.4	+52 34	10.3—11.4	7 07.9	5 20		13 4		20 12		27	20
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	3 18		10 13		17 8		24	3
RZ Centauri	12 55.6	—64 05	8.5— 8.9	1 21.0	6 19		14 7		21 19		29	7
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.1	1 8		10 22		15 18		25	8
SS Centauri	07.2	—63 37	8.8—10.4	2 11.5	7 14		15 1		22 11		29	21
SX Hydræ	13 39.0	—26 23	8.6—12.7	2 21.5	5 8		11 3		22 17		28	12
δ Libræ	14 55.6	— 8 07	4.8— 6.2	2 07.9	5 15		12 14		19 14		26	13
U Coronæ	15 14.1	+32 01	7.6— 8.7	3 10.9	5 8		12 5		19 3		26	1

Minima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Minima in 1928							
					February							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
TW Draconis	15 32.4	+64 14	7.3— 8.9	2 19.4	3 16	12 2	20 12	28 22				
SS Libræ	15 43.4	—15 14	9.3—11.5	0 18.4	6 6	13 11	20 15	27 20				
SW Ophiuchi	16 11.1	— 6 44	9.2—10.0	2 10.7	7 1	14 9	21 17	29 1				
SX Ophiuchi	12.6	— 6 25	10.5—11.2	2 01.5	1 21	8 2	20 11	26 15				
R Aræ	31.1	—56 48	6.8— 7.9	4 10.2	6 4	15 1		23 21				
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1		16 6						
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	5 0	11 19	18 14	25 9				
U Ophiuchi	11.5	+ 1 19	6.0—6.7	1 16.2	3 1	9 18	23 4	29 21				
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	1 9	7 13	19 20	26 0				
TX Herculis	15.4	+42 00	8.3— 9.0	2 01.4	6 6	12 10	18 14	24 19				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	7 17	15 2	22 11	29 20				
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	3 9	13 5	18 3	27 22				
TX Scorpii	48.6	—34 13	7.5— 8.2	0 22.6	2 19	9 19	22 14	29 4				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	2 9	13 7		24 2				
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	3 20	11 20	19 20	27 20				
WX Sagittarii	53.6	—17 24	9.2—10.8	2 03.1	2 5	8 15	21 9	27 19				
WY Sagittarii	17 54.9	—23 01	9.5—10.6	4 16.0	1 9	10 17	20 2	29 10				
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	2 22	13 6	18 10	28 18				
RS Sagittarii	11.0	—34 08	5.9— 6.3	2 10.0	6 2	13 7	20 13	27 19				
V Serpentis	11.1	—15 34	9.5—11.1	3 10.9	4 15	11 12	18 10	25 8				
RZ Scuti	21.1	— 9 15	7.4— 8.3	15 03.2		14 22						
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	7 16	15 9		23 2				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	5 1	13 23		22 20				
SX Sagittarii	39.7	—30 36	8.7— 9.8	2 01.8	3 18	12 1	20 9	28 16				
RR Draconis	40.8	+62 34	9.3—13	2 19.9	5 16	14 4	22 16					
RS Scuti	43.7	—10 21	9.3—10.3	0 15.9	1 14	9 13	17 13	25 12				
β Lyræ	46.4	+33 15	3.4— 4.1	12 21.8	7 20		20 18					
U Scuti	18 48.9	—12 44	9.1— 9.6	0 22.9	7 12	14 3	22 19					
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	6 21	14 11	22 1	29 14				
RV Lyræ	12.5	+32 15	11. —12.8	3 14.4	5 12	12 16	19 21	27 2				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	9 7		18 6	27 5				
U Sagittæ	14.4	+19 26	6.5— 9.0	3 09.1	4 14	11 9	18 3	24 21				
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	7 18	15 3	22 12	29 21				
TT Lyræ	24.3	+41 30	9.4—11.6	5 05.8	4 11	9 17	20 5	25 11				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	1 21	11 1	19 5	27 8				
SY Cygni	19 42.7	+32 28	10. —12	6 00.2	4 2	10 3	22 3	28 3				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	9 0		18 23	28 21				
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	9 19		18 22	28 1				
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	8 6	16 6		25 2				
RW Cancri.	12.2	—17 59	8.8—10.6	3 09.4	5 6	12 5	19 1	25 19				
UW Cygni	19.6	+42 55	10.5—13	3 10.8	3 21	10 18	17 16	24 13				
V Vulpec.	32.3	+26 15	8.2— 9.8	37 19.0								
W Delphini	33.1	+17 56	9.4—12.1	4 19.4		10 2	19 17	29 7				
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	3 21	13 21	17 20	27 0				
Y Cygni	48.1	+34 17	7.1— 7.9	2 23.9	6 11	12 23	18 11	24 10				
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	5 1	12 22	19 8	26 11				
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	5 23	11 0	21 3	26 4				
RY Aquarii	21 14.8	—11 14	8.8—10.4	1 23.2	5 18	11 16	23 11	29 8				
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3		15 12						
RT Lacertæ	21 57.4	+43 24	9.1—10.5	5 01.7	6 2	11 3	21 7	26 9				
RW Lacertæ	22 40.6	+49 08	10.2—11.2	5 04.4	2 6	12 16	17 14	28 4				
VW Pegasi	22 51.7	+32 42	10.0—10.6	5 06.4	1 6	11 20	17 2	27 16				
Y Piscium	23 29.3	+ 7 22	9.0—12.0	3 18.4	4 7	11 19	19 8	26 21				
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	2 6	10 12	18 18	27 0				

Maxima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Maxima in 1928 February							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7					20 7			
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 01.7	3 14	11 18	19 21	28 0				
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	2 3	13 5	18 17	29 19				
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2		14 19		29 14				
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	3 12	10 10	17 9	24 8				
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	6 16	14 11	22 6					
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0		11 0		27 10				
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	3 15	12 5	20 19	25 2				
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1		10 10	21 13					
RX Aurigæ	4 54.5	+39 49	7.2— 8.1	11 15.0	3 5	14 20		26 11				
SX Aurigæ	5 04.6	+42 02	8.0— 8.7	1 12.8	6 5	12 8	18 11	24 14				
SY Aurigæ	05.5	+42 41	8.4— 9.5	10 03.3	7 20		17 23	28 2				
Y Aurigæ	21.5	+42 21	8.6— 9.6	3 20.6	5 0	12 17	20 11	28 4				
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	3 21	9 10	20 12	26 0				
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	3 8	10 22	18 11	26 1				
T Monoc.	19 8	+ 7 08	5.7— 6.8	27 00.3			19 11					
RT Aurigæ	23.0	+30 33	5.1— 6.0	3 17.5	2 8	9 19	17 6	24 17				
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	5 0	12 22	20 20	28 18				
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	4 3	14 7		24 11				
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5		8 11						
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	6 6	14 5	22 3					
V Carinæ	8 26.7	—59 47	7.4— 8.1	6 16.7	7 4	13 21	20 14	27 6				
T Velorum	8 34.4	—47 01	7.6— 8.5	4 15.3	3 13	12 20	17 11	26 18				
V Velorum	9 19.2	—55 32	7.5— 8.2	4 08.9	3 16	12 19	21 3	29 21				
Z Leonis	9 46.4	+27 22	7.9— 9.6	56 08.7								
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	4 1	13 1	17 14	26 15				
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	2 8	8 22	22 3	28 18				
S Muscæ	12 07.4	—69 36	6.4— 7.3	9 15.8	8 10		18 2	27 17				
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	4 20	10 13	21 22	27 15				
T Crucis	15.9	—61 44	6.8— 7.6	6 17.6	4 23	11 17	18 10	25 4				
R Crucis	18.1	—61 04	6.8— 7.9	5 19.8	2 15	8 11	20 2	25 22				
S Crucis	12 48.4	—57 53	6.5— 7.6	4 16.6	2 12	11 21	16 14	26 0				
W Virginis	13 20.9	— 2 52	8.7—10.4	17 06.5	5 2		22 9					
SS Hydræ	25.0	—23 08	7.4— 8.1	8 04.8	7 3	15 7		23 12				
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	6 15		16 0	25 4				
ST Virginis	14 22.5	— 0 27	10.3—11.4	0 09.9	2 5	10 10	18 15	26 20				
V Centauri	25.4	—56 27	6.4— 7.8	5 11.9	6 5	11 17	22 16	28 4				
RS Bootis	14 29.3	+32 11	8.9—10.0	0 09.1	6 23	14 12	22 2	29 15				
R Trian. Austr.	15 10.8	—66 08	6.7— 7.4	3 09.3	4 7	11 2	17 21	24 15				
S Trian. Austr.	15 52.2	—63 29	6.4— 7.4	6 07.8	3 0	9 7	21 23	28 7				
S Normæ	16 10.6	—57 39	6.6— 7.6	9 18.1	2 20	12 14	22 8					
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	3 13	10 5	16 20	23 11				
RV Scorpii	16 51.8	—33 27	6.7— 7.4	6 01.5	6 19	12 20	18 22	24 23				
X Sagittarii	17 41.3	—27 48	4.4— 5.0	7 00.3	1 21	8 22	22 22	29 22				
Y Ophiuchi	47.3	— 6 07	6.1— 6.5	17 02.9		7 17		24 20				
W Sagittarii	17 58.6	—29 35	4.3— 5.1	7 14.3	7 9	14 23	22 14					
Y Sagittarii	18 15.5	—18 54	5.4— 6.2	5 18.6	1 15	7 9	18 22	24 17				
U Sagittarii	26.0	—19 12	6.5— 7.3	6 17.9	5 3	11 21	18 15	25 9				
Y Scuti	32.6	— 8 27	8.7— 9.2	10 08.3	1 6	11 15	21 23					
RZ Lyræ	39.9	+32 42	9.9—11.2	0 12.3	7 13	15 5	22 21					
RT Scuti	44.1	—10 30	9.1— 9.7	0 11.9	6 12	13 23	21 9	28 20				

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Maxima in 1928 February							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
κ Pavonis	18 46.6	—67 22	3.8— 5.2	9 02.2	7 15			16 17	25 20			
U Aquilæ	19 24.0	— 7 15	6.2— 6.9	7 00.6	2 4	9 5	16 6	23 6				
XZ Cygni	30.4	+56 10	8.6— 9.3	0 11.2	4 5	11 5	18 5	25 5				
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	5 20	13 20	21 20					
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	1 8	9 1	16 17	24 9				
η Aquilæ	47.4	+ 0 45	3.7— 4.5	7 04.2	7 2	14 6	21 10	28 14				
S Sagittæ	51.5	+16 22	5.6— 6.4	8 09.2	0 20	9 5	17 14	25 23				
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	4 4	10 11	16 19	23 3				
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	4 7		20 16					
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	3 18	12 15	17 1	25 22				
UY Cygni	52.3	+30 03	9.6—10.4	0 13.5	2 21	8 12	19 17	25 7				
RV Capric.	55.9	—15 37	9.2—10.1	0 10.7	5 0	13 23	18 11	27 10				
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4		14 20		29 13				
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	3 11	11 8	19 4	27 1				
SW Aquarii	10.2	— 0 20	9.9—10.8	0 11.0	1 9	10 14	15 4	24 8				
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	5 7	15 1	19 21	29 15				
Y Lacertæ	22 05.2	+50 33	9.1— 9.6	4 07.8	3 21	12 12	21 4	29 20				
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	2 1	12 18	18 3	28 21				
Z Lacertæ	36.9	+56 18	8.2— 9.0	10 21.1	5 18		16 16	27 13				
RR Lacertæ	37.5	+55 55	8.5— 9.2	6 10.1	5 13	11 23	18 9	24 19				
V Lacertæ	44.5	+55 48	8.5— 9.5	4 23.6	1 13	11 12	16 11	26 11				
X Lacertæ	22 45.0	+55 54	8.2— 8.6	5 10.7	5 0	10 11	21 8	26 19				
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	1 20	12 17	18 3	29 0				
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	6 16	12 23	19 6	25 13				
RY Cassiop.	23 47.2	+58 11	9.3—11.8	12 03.4	2 15	14 18		26 21				

Monthly Report of the American Association of Variable Star Observers, for the Month of November, 1927.

Whether due to improved observing conditions or to the increased interest as the result of the recent annual meeting of the Association, the fact remains that the reports for the past month have been more numerous, more lengthy, and more reliable. As the summary given at the end indicates, forty observers are included, with a total of 1,785 observations secured on 379 variables. Among new observers cited are Messrs. Thos. Fisher, Ford, Kelly, Soberanes, and F. L. Williams. Mr. Bouton returns to the active list of contributors with a highly creditable report.

President Pickering reports very favorable responses to his appeal for members to take out Sustaining Memberships, these to be known as the "Old Guard" of the Association. Members who are in a position to do so, especially those who are unable to take an active part in the observing program, are urged to join this class and thus aid in furthering the progress of the Association.

An examination of the monthly summary shows that some observers secure many observations of a few stars, while others distribute theirs more uniformly over a large list of variables. An examination of the annual summary—to appear in the reprint for 1927—reveals many stars insufficiently observed and members are requested to pay particular attention to these stars and, if necessary, ask for more charts with which to extend their observing program. Twenty observations

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1927.

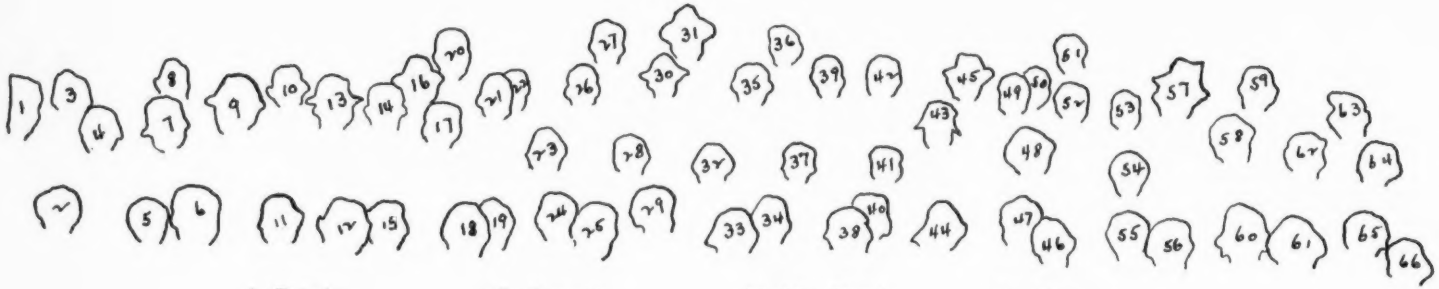
Sept. 0 = J.D. 2425124; Oct. 0 = J.D. 2425154; Nov. 0 = J.D. 2425185.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V SCL	S TUC	— CAS	Y AND	o CET	W PER
000339	*001862*	004746b	013338	*021403*	024356
150[13.3 Bl	125 12.5 Sm	179 10.9 Ie	189 8.2 B	179 5.0 Ho	197 9.5 Eb
S SCL	126 11.9 En	W CAS	X CAS	180 5.0 Ho	199 9.4 Bx
001032	140[13.2 Sm	004958	014958	181 4.8 Sp	199 9.3 Fs
125 9.8 Ht	141[11.9 En	171 8.3 B	171 12.0 B	181 4.8 B	200 9.4 Hu
125 10.0 Sm	147[12.4 En	174 8.6 Pt	172 12.6 Bn	183 4.6 Sp	203 9.3 Rt
126 9.4 En	150 14.5 Bl	177 8.7 Jo	177 12.5 Pt	184 4.6 Jo	R HOR
130 9.3 Bl	S CET	182 8.5 B	185 11.4 B	184 5.4 Ho	*025050*
131 9.7 Sm	*001909*	184 8.6 Jo	185 12.4 Bn	184 5.0 Ie	125 12.6 Ht
139 9.0 Bl	179 [9.3 Rt	200 8.5 Hu	200 10.8 B	187 5.0 Bu	130 12.5 Bl
140 8.7 Ht	180 14.5 L	U TUC	RR ARI	187 4.0 Rw	139 11.6 Bl
140 9.1 Sm	T PHE	*005475*	015023	197 5.0 Sp	140 12.2 Ht
141 8.8 En	*002546*	126 8.2 En	123 5.8 H	200 5.3 Sp	140 12.2 Sm
146 7.6 En	140[13.0 Sm	130 9.1 Bl	155 5.8 H	200 5.0 Rw	142 12.2 En
147 8.3 Ht	142[13.0 En	131 8.9 Sm	175 5.8 H	200 5.6 Hu	147 12.2 En
150 7.7 Bl	150 14.0 Bl	139 8.8 Bl	176 5.8 H	200 5.3 Bu	147 11.8 Ht
150 8.9 Sm	W SCL	140 8.9 Sm	178 5.8 H	206 5.6 Bu	149 12.2 Sm
151 7.9 Ht	*002833*	141 8.7 En	U PER	S PER	150 11.5 Bl
153 7.9 En	150 13.0 Bl	147 9.2 En	015254	021558	151 11.6 Ht
X AND	Y CEP	150 9.2 Bl	177 9.8 Pt	177 9.3 Pt	154 12.0 Sm
001046	003179	Z CET	179 10.0 Jo	179 10.0 Jo	T HOR
127 10.1 Bf	179 10.2 B	*010102*	180 10.2 B	180 9.8 B	*025751*
169 12.0 Bf	184 10.8 Ie	174 10.8 Pt	196 10.2 B	200 9.4 B	126[12.7 Bl
173 12.0 Bg	190 11.0 B	178 10.7 B	S ARI	204 9.4 Hu	149 12.7 Sm
176 12.3 B	200 11.0 Hu	189 9.5 B	015912	RR PER	150 12.9 Bl
179 12.5 Ie	U CAS	U SCL	178[14.0 B	022150	154 12.5 Sm
T CET	004047	*010630*	200 14.2 B	177 13.0 Pt	U ARI
001620	174 13.4 Pt	130[12.0 Bl	R ARI	181 12.9 B	030514
179 5.8 L	180 12.6 B	150 13.0 Bl	021024	200 13.4 B	130 12.1 Bf
T AND	197 11.9 Eb	U AND	177 11.5 Pt	R FOR	169 12.9 Bf
001726	197 11.9 Kz	010940	181 11.5 B	*022426*	181 14.0 B
174 12.2 Pt	198 11.7 Cl	176[13.2 B	187 11.5 Bu	130 11.3 Bl	X CET
176 11.7 B	RW AND	UZ AND	197 8.5 Fd	139 11.2 Bl	*031401*
197 11.0 Eb	004132	011041	198 8.3 Fd	150 11.0 Bl	180 11.1 L
197 11.1 Kz	174 13.8 Pt	176 14.1 B	W AND	RR CEP	180 10.8 B
200 10.9 Ie	V AND	S PSC	021143a	022980	197 10.0 Eb
203 10.7 Rt	004435	011208	177 12.7 Pt	168 12.1 Bl	197 9.7 Kz
T CAS	127[14.4 Bf	178[12.8 B	200 13.3 B	177 11.0 Pt	203 9.8 Rt
001755	169 11.2 Bf	S CAS	T PER	181 11.3 Bl	Y PER
161 11.8 L	176 10.8 B	011272	021258	184 11.5 Ie	032043
171 11.4 B	189 10.5 B	182[12.6 B	177 8.6 Pt	R TRI	173 10.0 Gb
174 11.8 Pt	200 9.8 B	RZ PER	179 8.5 Jo	023133	177 9.4 Pt
178 12.0 Ie	200 10.0 Hu	012350	204 8.4 Hu	177 6.6 Jo	181 10.8 B
181 12.0 L	X SCL	176 11.0 B	Z CEP	177 6.3 Pt	183 9.4 Jo
182 12.2 B	*004435*	189 10.6 B	021281	181 6.0 B	186 9.2 Ky
197 12.2 Eb	150 13.0 Bl	R PSC	177 11.8 Pt	184 6.4 Jo	196 9.8 B
197 12.1 Kz	RR AND	012502	181 11.8 B	197 5.8 Kz	197 9.7 Ky
R AND	004533	127 13.7 Bf	184 12.0 Ie	197 5.6 Eb	197 9.5 Eb
001838	127 13.2 Bf	RU AND	o CET	200 7.0 Hu	199 9.6 Fs
174 8.8 Pt	169[14.3 Bf	013238	*021403*	W PER	203 9.6 Bx
176 9.0 B	RV CAS	174 11.0 Pt	149 4.1 Sm	024356	204 8.5 Hu
177 8.8 Jo	004746a	176 10.7 B	154 4.1 Sm	177 9.5 Pt	R PER
184 8.8 Jo	174 13.3 Pt	179 10.8 Ie	157 3.8 L	180 9.7 B	032335
186 9.4 Wm	179 14.0 Ie	189 10.4 B	174 4.4 Sp	186 9.4 Bx	177 9.2 Pt
186 9.3 Sb	180 13.6 B	Y AND	177 4.0 Jo	186 9.4 Fs	181 8.6 B
187 9.0 Rw	— CAS	013338	178 3.9 L	186 9.3 Ky	196 8.7 B
200 9.8 Rt	004746b	174 9.5 Pt	178 3.9 Be	196 9.5 B	197 8.7 Eb
203 9.8 Rt	174 10.5 Pt	176 9.2 B	179 4.6 Sp	197 9.2 Kz	197 8.4 Kz

PLATE I

AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS, CAMBRIDGE, MASSACHUSETTS, OCTOBER 22, 1927.

KEY TO PLATE I.



1 Prentice
2 Mrs. Boss
3 King
4 Miss Durkee
5 Miss Card
6 Kearons
7 Miss Jordan
8 Waterfield
9 Jordan
10 Boss
11 Miss Roper
12 Gerasimovic
13 Barnes
14 Fisher
15 Miss Fairfield
16 Whitehorn
17 Howard
18 Miss Young
19 Mrs. Holmes
20 Luyten
21 Lubrano
22 Sawyer
23 Miss Hodgdon
24 Miss Emerson
25 Jones
26 Rittenberg
27 Brouwer
28 Brown
29 Miss Bigelow
30 Olcott
31 Yalden
32 Miss Cannon
33 Miss Farnsworth
34 Miss Clough
35 Lutz
36 Ingham
37 Shapley
38 Pickering
39 Clement
40 Miss Sweetzer
41 Mrs. Sawyer
42 Logan
43 Mrs. Leavens
44 Mrs. Schilt
45 Mowry
46 Mayall
47 Schilt
48 Miss Cushman
49 Stetson
50 Waldo
51 Hogg
52 Miss Harwood
53 Potter
54 Miss Gill
55 Miss Cummings
56 Mrs. Mayall
57 Reardon
58 Mrs. Kearons
59 Allen
60 Miss Woods
61 Miss Howarth
62 Miss Walker
63 Irwin
64 Miss Maury
65 Campbell
66 Miss Campbell

Variable Star Observations Received During November, 1927.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
U Cam	R Dor	T Col	SU Tau	X Aur	S CMi
033362	*043562*	*051533*	054319	060450	072708
182 8.2 By	142 5.6 En	127 12.1 Ht	182 9.5 L	176 11.3 Pt	203 8.1 Rt
X Per	147 5.5 En	148 11.6 Ht	184 9.6 Pt	V Mon	S Vol
034930	148 5.2 Ht	150 11.3 Bl	184 10.0 Ie	*061702*	*073173*
182 6.2 By	149 5.8 Sm	S Aur	185 9.7 L	176 8.2 Pt	126[13.2 Bl
R Tau	150 5.3 Bl	052034	190 9.6 Pt	— Aur	150[13.2 Bl
042209	154 5.8 Sm	176 8.2 Pt	191 9.7 Pt	062047	U CMi
130 12.9 Bf	R Cae	197 8.5 Kz	203 9.5 Bx	157 9.7 L	073508
176 10.2 Pt	*043738*	197 8.9 Eb	S Col	182 9.8 L	157 10.4 L
189 8.8 B	126 9.7 Bl	W Aur	*054331*	R Mon	182 11.1 L
200 8.5 B	127 9.8 Ht	052036	126[13.5 Bl	063308	191 11.5 Pt
W Tau	143 10.6 Ht	157 11.7 L	150 13.3 Bl	176 10.6 Pt	S Gem
042215	148 10.8 Ht	180 12.3 L	Z Tau	Nov Pic	073723
176 9.8 Pt	150 10.7 Bl	190 12.5 B	054615a	*063462*	191 12.5 Pt
177 10.6 Jo	R Pic	199 12.6 B	130 10.6 Bf	127 6.3 Ht	W Pup
179 10.6 Rt	*044340*	S Ori	184 12.8 Ie	148 6.5 Ht	*074241*
184 10.0 Jo	126 7.1 Bl	*052404*	RU Tau	S Lyn	126 10.3 Bl
189 9.6 B	150 7.6 Bl	176 12.5 Pt	054615c	063558	150 11.4 Bl
197 10.3 Eb	V Tau	T Ori	130[13.5 Bf	176 13.3 Pt	T Gem
197 10.0 Kz	044617	*053005a*	184[13.1 Ie	W Mon	074323
200 9.8 Jo	184[13.0 Ie	157 11.5 L	R Col	*064707*	191 9.4 Pt
200 10.0 Sp	199 13.7 B	171 10.6 Pt	*054620*	176 9.8 Pt	R Cnc
S Tau	R Ori	176 10.6 Pt	126[13.0 Bl	Y Mon	081112
042309	045307	180 11.0 Pt	150[13.0 Bl	065111	191 11.5 Pt
130 12.1 Bf	203 10.0 Bx	181 10.9 Pt	U Ori	176 9.2 Pt	Z Cam
189[13.0 B	R Lep	182 10.5 L	054920a	X Mon	081473
203[11.9 Bx	*045514*	184 10.4 Pt	176 6.6 Pt	*065208*	179 12.6 L
T Cam	157 7.3 L	185 10.2 L	177 7.2 Jo	157 7.8 L	V Cnc
043065	176 7.6 Pt	190 10.8 Pt	197 9.0 Fd	182 7.4 L	081617
161 9.7 Wk	177 8.0 Jo	191 10.5 Pt	197 7.8 Kz	203 8.5 Rt	191 8.9 Pt
161 9.7 L	182 7.4 L	AN Ori	197 7.7 Eb	R Gem	R Cha
176 10.2 Pt	197 6.2 Fd	*053005t*	198 9.0 Fd	070122a	*082476*
181 10.1 L	204 7.0 Ho	157 11.3 L	203 7.9 Rt	174 7.5 Al	126 13.0 Bl
RX Tau	V Ori	185 10.8 L	V Cam	191 7.0 Pt	150[13.0 Bl
043208	050003	S Cam	054974	Z Gem	S Hya
182 11.6 B	176 11.4 Pt	053068	189[13.1 B	070122b	084803
197 10.7 Eb	T Lep	169 10.6 Wk	Z Aur	191 12.5 Pt	191 10.5 Pt
197 10.5 Kz	*050022*	176 10.5 Pt	055353	TW Gem	T Hya
200 10.3 B	126 12.3 Bl	RR Tau	171 10.0 Pt	070122c	*085008*
203 10.6 Bx	130 12.6 Bf	053326	172 10.1 Pt	191 7.5 Pt	182 9.0 L
R Ret	150 11.1 Bl	130 11.8 Bf	173 10.1 Pt	R CMi	191 9.0 Pt
043263	176 11.0 Pt	RU Aur	174 10.0 Pt	070310	T Cnc
125[12.2 Ht	S Pic	053337	175 10.0 Pt	157 7.5 L	085120
147[12.2 En	*050848*	176[12.4 Pt	176 10.2 Pt	182 7.9 L	191 7.7 Pt
149[12.2 Sm	126 9.8 Bl	197[11.2 Kz	177 10.2 Pt	R Vol	T Pyx
150[12.5 Bl	150 10.7 Bl	U Aur	179 10.2 Pt	*070772*	*090031*
154[12.2 Sm	R Aur	053531	180 10.1 Pt	127 10.1 Ht	126 [s Bl
X Cam	050953	176 12.5 Pt	181 9.9 Pt	143 10.4 Ht	150 [u Bl
043274	176 9.4 Pt	200 10.8 B	184 10.2 Pt	148 10.7 Ht	V UMa
176 12.3 Pt	197 9.3 Kz	Y Tau	189 10.2 Pt	149 11.3 Sm	090151
182 13.4 B	197 9.6 Eb	053920	190 10.3 Pt	V Gem	182 10.5 L
199 12.5 B	T Pic	198 7.0 Fd	191 10.6 Pt	071713	W Cnc
R Dor	*051247*	SU Tau	196 10.6 Pt	191 13.2 Pt	090425
043562	126 13.8 Bl	054319	197 10.6 Pt	S CMi	157[12.6 L
125 5.1 Ht	143[13.1 Ht	157 9.7 L	198 10.6 Pt	072708	182[15.0 L
126 5.8 Bl	150[13.1 Bl	171 9.6 Pt	R Oct	177 8.5 Jo	RW Car
139 5.3 Bl	T Col	176 9.5 Pt	*055686*	191 8.2 Pt	*091868*
140 5.6 Sm	*051533*	180 9.6 Pt	139 12.1 Bl	197 8.6 Fd	138 11.2 Bl
141 5.2 Ht	126 11.9 Bl	181 9.6 Pt	150 12.2 Bl	200 8.3 Jo	148 11.1 Bl

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1927.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
Y VEL	RS CAR	U OCT	T APS	S APS	W LIB
092551	*110361*	*131283*	*134677*	*145971*	*153215*
150 13.5 Bl	125[12.3 Sm	138 11.9 Bl	125 10.6 Sm	125 10.0 En	129 11.7 Bl
R CAR	S LEO	140 12.0 Ht	126 11.0 En	125 10.4 Sm	138 12.5 Bl
092962	110506	140 12.2 Sm	129 10.0 Bl	129 10.0 Bl	S UMI
129 7.0 Bl	191 9.6 Pt	141 12.1 En	131 10.0 Sm	131 10.4 Sm	153378
138 7.9 Bl	RY CAR	147 11.8 En	138 9.7 Bl	137 9.8 En	169 8.6 Pt
148 8.5 Bl	*111561*	147 11.6 Ht	140 9 8 Sm	138 10.0 Bl	177 8.5 Jo
R LMI	144[13.1 Bl	148 11.5 Bl	141 9.4 En	140 10.4 Sm	189 8.0 Jo
093934	RS CEN	149 11.6 Sm	146 8.4 En	142 10.4 Sm	200 7.6 Jo
174 10.8 Al	*111661*	151 11.3 Ht	148 9.1 Bl	143 10.0 En	203 8.2 Rt
191 12.2 Pt	125[12.7 Sm	154 11.2 Sm	150 9.0 Sm	148 10.0 Bl	U LIB
R LEO	144[13.1 Bl	R HYA	RU HYA	149 10 0 En	*153620a*
094211	W CEN	*132422*	*140528*	149 10.1 Sm	145[12.4 Bl
191 5.7 Pt	*115058*	126 4.0 En	125[12.5 Fn	150 10.2 Sm	T NOR
197 6.9 Fd	125 12.2 Ht	129 4.6 Bl	144[12.9 Bl	154 10.4 Sm	*153654*
197 5.8 Eb	126 12.2 En	137 4.1 En	R CEN	S SER	125 12.5 En
197 5.6 Kz	129 12.3 Bl	138 4.6 Bl	*140950*	151714	125 12.8 Ht
199 5.0 Fz	141 12.6 Ht	S VIR	125 6.4 En	161 9.8 L	137 11.6 En
203 5.7 Rt	144 12.6 Bl	*132706*	125 6.4 Ht	169 10.0 Pt	140 11.1 Sm
X LEO	SU VIR	131 9.4 Sm	129 6.2 Bl	180 11.0 L	140 11.6 Ht
094512	120012	RV CEN	131 6.0 Sm	S CRB	143 10.8 En
182 12.4 L	191 9.8 Pt	*133155*	137 6.2 En	151731	147 10.5 Ht
185 12.9 L	SS VIR	129 9.5 Bl	138 5.8 Bl	149 11.2 Wm	149 10.1 En
Z VEL	122001	138 9.4 Bl	140 6.0 Sm	156 10.9 Wm	150 10.2 Sm
094953	182 6.7 L	148 9.3 Bl	140 5.9 Ht	169 9.5 Wk	151 10.4 Ht
138 12.2 Bl	T CVN	T UMI	141 6.2 En	169 9.8 Pt	153 9.7 En
150 13.0 Bl	122532	133273	146 6.1 En	171 9.5 Wm	Z LIB
V LEO	191 12.1 Pt	203 10.3 Rt	147 5.9 Ht	171 9.8 Sb	*154020*
095421	U CEN	T CEN	148 5.8 Bl	185 8.4 Wm	145 12.4 Bl
191 8.4 Pt	*122854*	*133633*	150 5.8 Sm	RS LIB	R CRB
RV CAR	129 11.9 Bl	112 7.8 Bf	151 5.7 Ht	*151822*	154428
095563	138 11.6 Bl	125 6.8 En	153 6.0 En	125 8 0 En	023 6.0 H
144[13.1 Bl	148 10.5 Bl	125 6.5 Ht	U UMI	125 8.2 Ht	027 6.2 H
S CAR	R UMA	129 5.5 Bl	141567	129 7 8 Bl	028 6.2 H
100661	123160	131 5.9 Sm	161 9.0 Wk	131 7.9 Sm	030 6.0 H
125 8.0 Sm	169 9.6 Wk	137 6.3 En	169 8.6 Pt	137 7.6 En	031 6.0 H
129 8.6 Bl	173 9 6 Cb	138 5.9 Bl	186 8.7 Gb	138 7.8 Bl	057 6.2 H
138 8.5 Bl	177 9.8 Jo	141 5.9 Ht	186 8.4 Wm	140 7.7 Ht	060 6.2 H
148 7.4 Bl	191 10.2 Pt	148 5.9 Ht	186 8.4 Sb	140 7.9 Sm	147 5.8 Fd
Z CAR	R VIR	148 5.9 Bl	S BOO	143 7.6 En	149 6.2 Wm
101058	123307	RT CEN	141954	147 7.8 Ht	155 6.1 Be
144[12.3 Bl	191 11.0 Pt	*134236*	169 9.0 Pt	148 7.7 Bl	156 6.0 Wm
W VEL	RS UMA	125 11.7 En	179 9.0 L	149 7.7 Fn	156 5.4 Fd
101153	123459	125 11.4 Ht	V BOO	150 7.5 Sm	157 5.3 Fd
150[13.0 Bl	173[12.6 Cb	131 11.7 Sm	142539a	151 7.7 Ht	158 5.6 Fd
U HYA	191 13.2 Pt	137 11.4 En	169 8.6 Pt	R NOR	160 6.1 L
103212	S UMA	138 10.8 Bl	197 6.4 Fd	*152849*	161 6.0 L
182 5.1 L	123961	140 10.9 Sm	R BOO	125 12.8 En	161 6.1 Be
185 4.9 L	169 8.0 Wk	141 10.7 Ht	143227	137 12.6 En	164 5.5 Fd
R UMA	173 7.1 Cb	148 10.0 Ht	169 12.2 Pt	140 12 6 Sm	167 6.0 Be
103769	177 8.5 Jo	148 10.1 Bl	Y LUP	143 12.3 En	168 5.9 Fd
147 10.3 Fd	184 8.0 Jo	R CVN	*145254*	144 12.0 Bl	169 6.2 Pt
157 10.6 Fd	191 7.5 Pt	134440	129 10.7 Bl	149 11.8 En	171 6.2 Sb
158 10.5 Fd	200 7.6 Jo	191 9.7 Pt	131 11.0 Sm	150 12.2 Sm	171 6.1 Wm
164 10.4 Fd	203 8.1 Rt	RX CEN	138 11.0 Bl	X LIB	172 6.2 Pt
191 11.8 Pt	U OCT	*134536*	140 11.3 Sm	*153020*	173 6.1 Pt
V HYA	*131283*	144[13.1 Bl	148 11.5 Bl	144 11.4 Bl	173 6.4 Fd
104620	125 13.2 Sm		150 11.7 Sm		173 6.0 Gb
182 8.5 L	125 12.9 Ht				174 6.1 Pt

Variable Star Observations Received During November, 1927.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R CrB	Z Sco	S Sco	R Dra	RT Sco	W Pav
154428	*160021*	*161122b*	163266	*165636*	*174162*
175 6.1 Pt	140 10.1 Ht	109 11.3 Bf	177 11.0 Jo	145[14.0 Bl	143 10.9 En
177 6.1 Pt	143 9.9 En	125[12.6 En	S Dra	R Oph	146 10.7 En
177 6.1 Be	147 10.1 Ht	125 12.6 Ht	164055	*170215*	147 11.0 Ht
178 6.4 Fd	148 9.7 Bl	127 12.3 Bg	159 8.5 By	169 8.1 Pt	148 11.3 Bl
178 6.0 L	149 9.9 Sm	137 13.9 Bf	182 8.1 By	RT Her	150 10.9 Sm
178 6.2 Pt	149 10.0 En	140[12.6 Sm	RR Oph	170627	151 11.0 Ht
179 6.2 Pt	151 10.2 Ht	145[12.6 Bl	*164310*	169 11.2 Pt	RS Oph
180 6.2 Pt	154 9.3 Sm	151[12.6 Ht	109 10.7 Bf	172 11.4 B	174406
180 6.0 Gb	R Her	166[14.2 Bf	125 11.8 En	RW Sco	169 11.2 Pt
181 6.1 L	160118	W CrB	125 11.8 Sm	*170833*	U Ara
181 6.1 Pt	163[12.9 GC	161138	127 11.9 Bg	129 11.0 Bl	*174551*
182 6.2 Pt	169 13.1 Pt	169 10.7 Pt	137 12.3 Bf	138 11.3 Bl	126[12.3 En
182 6.1 L	U Ser	180 11.2 Sp	149[12.0 En	148 11.4 Bl	140 12.8 Sm
183 6.1 L	160210	W Oph	166 13.2 Bf	Z Oph	149[13.0 Sm
184 6.1 Pt	169 8.5 Pt	*161607*	169 13.0 Pt	171401	153 12.6 En
185 6.1 Wm	X Sco	169 12.5 Pt	S Her	169 7.8 Pt	154 12.8 Sm
185 6.1 Be	*160221a*	179 12.2 L	164715	172 7.8 B	RT Oph
185 6.1 L	129 11.0 Bl	V Oph	156 9.8 By	174 7.7 Sp	175111
186 6.1 Pt	138 11.2 Bl	*162112*	158 9.3 By	197 7.9 Sp	169 9.4 Pt
186 6.0 Gb	148 11.7 Bl	169 7.8 Pt	163 9.0 By	RS Her	183 9.4 B
191 6.2 Fd	SX Her	U Her	169 9.5 Pt	171723	199 9.8 B
192 5.8 Fs	160325	162119	RS Sco	169 8.0 Pt	T Dra
194 6.2 Sp	161 7.9 L	156 9.0 Fd	*164844*	174 7.8 B	175458a
196 6.2 Pt	169 8.0 Pt	157 9.4 Fd	125 11.2 En	S Oct	159[12.6 GC
197 6.2 Pt	172 8.1 Pt	158 8.8 Fd	125 11.6 Sm	*172486*	172 12.9 B
197 6.1 Sp	173 8.0 Pt	158 9.0 By	125 11.2 Ht	125[12.8 Ht	183[12.4 B
198 6.2 Pt	174 8.0 Pt	163 8.8 By	129 11.2 Bi	126[12.8 En	UY Dra
199 5.8 Fs	175 8.0 Pt	164 8.4 Fd	138 11.1 Bl	140[13.0 Ht	175458b
200 6.0 Rw	177 8.1 Pt	168 8.6 Fd	140 11.2 Ht	141[12.8 En	172 10.0 B
X CrB	178 8.1 Pt	169 9.0 Pt	140 11.4 Sm	142[12.8 Sm	183 10.3 B
154536	179 8.1 Pt	173 9.2 Fd	141 11.0 En	145[13.0 Bl	RY Her
169 10.1 Pt	179 7.9 L	178 9.8 Fd	146 10.8 En	146[12.8 En	175519
V CrB	180 8.1 Pt	179 8.9 Jo	147 10.8 Ht	151[13.0 Ht	169 13.7 Pt
154639	181 8.2 Pt	SS Her	148 10.5 Bl	RU Oph	174 13.7 B
169 7.0 Pt	182 8.2 Pt	162807	149 10.7 Sm	172809	V Dra
RZ Sco	184 8.0 Pt	159 8.9 GC	151 10.5 Ht	169 13.0 Pt	175654
155823	186 8.2 Pt	169 10.4 Pt	153 10.4 En	183[13.0 B	169 12.3 Pt
125 12.0 En	196 8.0 Pt	174 10.4 GC	154 10.5 Sm	RT Ser	R Pav
125 12.2 Ht	197 8.3 Pt	179 11.5 L	RR Sco	*173212*	*180363*
137 12.0 En	198 8.3 Pt	T Oph	*165030*	179 12.7 L	126[11.8 En
140 11.1 Sm	W Sco	*162815*	125 9.5 En	RU Sco	140 12.0 Sm
141 11.6 Ht	*160519*	145[12.0 Bl	125 9.5 Ht	*173543*	140 12.3 Ht
143 11.2 En	145[12.0 Bl	S Oph	129 9.1 Bl	129 8.3 Bl	141 12.2 En
147 11.2 Ht	RU Her	*162816*	137 10.2 En	138 8.4 Bl	146 12.1 En
149 10.4 Sm	160625a	145[12.1 Bl	138 9.9 Bl	148 8.2 Bl	147 12.2 Ht
149 10.6 En	155 13.4 GC	W Her	140 10.6 Ht	SV Sco	149 11.9 Sm
151 10.7 Ht	169 14.1 Pt	163137	140 9.5 Sm	*174135*	151 12.1 Ht
153 10.4 En	179 14.0 L	169 8.5 Pt	143 10.4 En	145[12.2 Bl	153 11.8 En
154 10.0 Sm	R Sco	179 8.7 Jo	147 10.8 Ht	W Pav	154 11.8 Sm
Z Sco	*161122a*	179 8.7 Sp	148 10.2 Bl	*174162*	T Her
160021	125[12.6 En	191 9.8 Fd	149 10.6 En	125 10.2 Sm	180531
125 9.5 En	137[14.2 Bf	197 9.5 Sp	150 10.6 Sm	125 10.1 Ht	155 9.4 GC
125 10.4 Ht	145[12.6 Bl	200 9.7 Sp	151 10.8 Ht	126 10.1 En	159 9.3 GC
129 9.9 Bl	147[12.6 Ht	R Dra	153 10.8 En	129 10.0 Bl	168 9.1 GC
131 9.9 Sm	151[12.6 Ht	163266	RV Her	138 10.7 Bl	169 8.8 Pt
137 9.9 En	166 13.4 Bf	169 10.4 Wk	165631	140 10.9 Ht	174 8.6 GC
138 10.0 Bl		169 10.6 Pt	169 14.7 Pt	140 10.4 Sm	179 8.5 GC
140 9.9 Sm				141 10.7 En	179 8.4 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1927.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T HER	X OPH	R SCT	V AQL	RY SGR	RT AQL
180531	183308	*184205*	*185905*	*191033*	193311
179 8.5 Jo	169 6.4 Pt	182 5.9 Pt	173 7.0 Cb	138 6.0 Bl	171 12.2 B
180 8.7 Gb	172 6.8 B	182 6.2 Fd	R AQL	140 7.0 Sm	172 12.2 Pt
181 8.6 B	177 6.8 Jo	183 5.7 Jo	190108	140 6.5 Ht	183 11.2 B
183 8.5 GC	178 6.7 Rt	183 5.9 L	172 7.7 Pt	141 7.6 En	195 9.7 B
198 8.3 Hu	179 6.4 L	183 5.6 Sp	174 8.2 B	142 6.8 Sm	R CYG
199 9.0 B	184 6.4 Jo	184 6.0 Fd	183 8.4 Ya	143 6.5 Ht	193449
W DRA	189 7.0 B	184 5 8 Pt	186 8.7 B	145 6.2 Bl	163[13.1 GC
180565	198 7.3 Jo	184 5.8 Ie	RX SGR	146 6.9 En	173 13.7 Pt
169 12.8 Pt	204 7.5 Rt	185 5.6 L	*190818*	147 6.7 Ht	174 13.4 B
174 13.4 B	T AQL	186 5.5 Sp	172 11.0 Pt	148 6.0 Bl	178[13.1 GC
X DRA	184008	186 5.5 Pt	181 11.6 B	149 6.9 Sm	199 13.3 B
180666	156 9.6 By	186 5.8 Gb	RW SGR	151 6.5 Ht	RV AQL
169 10.9 Pt	179 9 2 By	189 5.5 Pt	*190819a*	151 6.2 Bl	193509
179 11.2 B	RV LYR	191 5.4 Sp	172 9.5 Pt	153 6.9 En	173 10.1 Pt
NOV OPH	184134	191 5.6 Fd	181 9.3 B	154 7.0 Sm	183 10.5 Ya
180911	169 11.7 Pt	192 5.3 Sp	TY AQL	160 6.4 L	TT CYG
169[12.0 Pt	199 13.5 Ie	193 5.4 Sp	190907	169 6 4 Pt	*193732*
TV HER	R SCT	194 5.4 Sp	172 10.2 Pt	171 6.2 Pt	198 7.1 Hu
181031	*184205*	194 5.6 Lg	S LYR	172 6.2 Pt	T PAV
179 10.5 L	147 5.8 Fd	195 5.7 Lg	190925	173 6.2 Pt	*193072*
RY OPH	156 7.3 Fd	196 5.9 Pt	172 13.9 B	174 6.3 Pt	125[13.2 Ht
181103	157 7.3 Fd	197 5.9 Pt	180[14 0 L	175 6.3 Pt	126 13.2 En
169 10.5 Pt	158 7.5 Fd	197 5 3 Sp	X LYR	177 6.3 Pt	140[13.2 Sm
178 9.2 B	160 8.1 L	197 5.2 Fd	190926	178 6.2 Pt	145 13.7 Bl
188 8.8 B	161 8.0 Be	198 5.1 Fd	159 8.6 By	178 6.4 L	146[13.2 En
199 8.8 B	162 7.9 Fd	198 5.7 Pt	172 8.9 Pt	179 6.3 Pt	147[13.2 Ht
W LYR	164 7.3 Fd	198 5.4 Sp	179 8.9 By	180 6.5 Pt	150[13.2 Sm
181136	167 8.1 Be	199 5.6 Ie	RS LYR	181 6.2 Pt	151 13.2 Ht
169 8 4 Pt	167 8.1 L	200 5.4 Sp	190933a	182 6.2 L	RT CYG
172 8.1 B	168 7.2 Fd	RW LYR	172 11.0 Pt	182 6.2 Pt	194048
177 8.4 Jo	169 8.0 Pt	184243	RU LYR	185 6.1 L	173 8 0 Pt
180 8.0 Gb	171 7.6 Pt	182[13.5 B	190941	186 6.2 Pt	174 8.0 B
183 8.0 B	172 7.5 Pt	NOV AQL	172 13 4 Pt	196 6 6 Pt	177 8.4 Jo
184 8.1 Jo	173 7.1 Pt	184300	199 11.7 Ie	197 6.5 Pt	179 8.2 Rt
198 8.2 Jo	173 6.9 Cb	172 11.1 Pt	203 11.0 Ya	198 6.4 Pt	184 7.7 Jo
198 8.3 Hu	173 7.0 Gb	177 11.1 Pt	U DRA	198 6.3 Ya	188 7.9 B
199 7.9 B	173 6.8 Fd	196 11.4 Pt	190967	TV SGR	192 7.9 Rt
RV SGR	174 7.0 Pt	RX LYR	172 12.6 Pt	*191124*	197 7.4 Kz
182133	174 7.1 Sp	185032	T SGR	129 11.5 Bl	197 7.7 Eb
121 8.7 Bl	175 7.0 Pt	172 14.5 Pt	*191017*	138 11.7 Bl	198 7.8 Jo
138 8.8 Bl	177 6.5 Pt	S CRA	155 8.3 GC	148 11.8 Bl	198 8.0 Hu
148 8.6 Bl	177 6.7 Sp	*185437a*	163 8.3 GC	S SGR	204 8.0 Rt
SV HER	177 6.9 Jo	129 11.7 Bl	172 8.5 Pt	*191310a*	TU CYG
182224	178 6.3 Rt	138 11.9 Bl	174 8.4 GC	145[12.9 Bl	194348
169 13.3 Pt	178 6.5 Fd	148 11.5 Bl	181 8.7 GC	SW SGR	174 13.0 B
171 13.2 B	178 6.4 Be	R CRA	R SGR	*191331*	188 12.8 B
179 13.2 L	178 6.5 L	*185537a*	*191019*	145[12.9 Bl	X AQL
189 13.5 B	178 6.5 Pt	138 13.0 Bl	172 10.0 Pt	TZ CYG	194604
T SER	178 6 5 Ie	148 13 0 Bl	174 10.5 Sp	191350	173 13.3 Pt
182306	179 6.2 Pt	T CRA	179 10 7 Sp	172 10.3 Pt	176 12.6 B
169 9 5 Pt	179 6.5 Sp	*185537b*	181 10.2 B	U LYR	188 11 0 B
174 9.6 B	179 6.4 Fd	138[13.0 Bl	RY SGR	191637	195 10.6 B
179 9.4 Sp	180 6.3 Fd	148[13.0 Bl	*191033*	172 9.0 Pt	198 10.5 Ya
180 9.4 Sp	180 6.1 L	Z LYR	125 7.2 En	TY CYG	199 10.9 Ie
195 9.8 B	180 6.2 Sp	185634	125 7.3 Sm	192928	X CYG
197 10.0 Sp	180 6.1 Pt	171 14.0 B	125 7.3 Ht	172 12.6 Pt	194632
	180 6.3 Gb	180[14.3 L	127 6.9 Ht		173 13.4 Pt
	181 5.9 Pt		129 7.2 Bl		176 13.3 B

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1927.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
χ CYG	R CAP	RS CYG	RW CYG	V CYG	T AQR
194632	*200514*	200938	202539	203847	*204405*
182 13.5 B	199 10.1 B	180 7.0 Gb	179 8.2 Rt	173 13.0 Pt	179 8.9 Sp
RR SGR	SV CYG	184 7.2 Al	204 8.4 Rt	176 13.1 B	180 8.8 Sp
194929	200647	184 7.4 Jo	RU CAP	199 13.4 B	186 8.6 B
129 8.3 Bl	159 9.6 By	194 7.3 Sp	*202622*	Y AQR	194 8.5 Sp
138 8.9 Bl	179 9.7 By	198 7.1 Jo	175[13.0 B	*203005*	197 8.9 Sp
148 9.6 Bl	179 9.3 Rt	205 7.8 Ya	199[12.0 B	173 9.5 Pt	200 8.9 Sp
RU SGR	190 9.3 B	R DEL	Z DEL	175 9.9 B	204 8.8 Rt
195142	192 8.5 Rt	201008	202817	180 10.8 Sp	205 8.8 Ya
125 7.5 Ht	198 8.4 Hu	172 11.5 B	176[13.4 B	186 10.2 B	RZ CYG
126 7.2 En	204 8.6 Rt	173 11.0 Pt	199 12.2 B	195 10.3 B	204846
129 7.3 Bl	S AQL	174 11.2 Sp	SZ CYG	200 10.7 Ie	173 10.1 Pt
131 7.4 Sm	200715a	178 10.6 L	202946	200 11.0 Sp	178 10.1 B
138 8.0 Bl	156 10.7 GC	179 11.0 Sp	169 9.6 Pt	205 10.8 Ya	180 10.4 GC
140 7.6 Sm	173 11.0 Pt	183 10.6 B	172 9.2 Pt	T DEL	185 10.5 GC
141 8.0 Ht	174 11.6 B	197 9.4 Sp	173 9.4 Pt	204016	189 10.3 B
141 7.8 En	176 11.3 GC	200 8.9 Sp	174 9.2 Pt	172 14.2 B	195 10.3 B
146 8.1 En	179 11.1 GC	200 8.9 B	175 9.0 Pt	173 14.5 Pt	S IND
147 8.1 Ht	182[10.6 Ya	203 8.9 Ya	176 8.8 Pt	179[12.5 Cl	*204954*
148 8.4 Bl	186 **11.4 B**	RT CAP	178 9.4 Pt	183[13.7 B	145 13.9 Bl
150 8.2 Sm	RW AQL	*201121*	179 9.0 Pt	199[14.2 B	X DEL
153 8.8 En	200715b	173 7.0 Pt	180 9.0 Pt	V AQR	205017
RR AQL	173 9.3 Pt	SX CYG	181 9.2 Pt	204102	186 11.8 B
195202	174 9.2 B	201130	182 9.6 Pt	156 8.9 By	199 11.6 B
171 8.6 B	182 9.0 Ya	173 8.3 Pt	184 9.8 Pt	173 8.0 Pt	R VUL
173 8.1 Pt	186 9.2 B	174 8.7 B	186 9.6 Pt	174 8.3 B	205923
182 9.0 Ya	R TEL	186 8.7 B	189 8.9 Pt	179 8.8 By	173 12.4 Pt
183 9.0 B	*200747*	199 8.9 Ie	190 8.8 Pt	186 8.4 B	178 11.7 B
195 9.2 B	129 8.5 Bl	RT SGR	190 9.6 B	195 8.4 B	184 10.5 Jo
203 9.5 Ya	138 8.6 Bl	*201139*	197 9.4 Pt	W AQR	189 10.4 B
RS AQL	148 8.3 Bl	145[12.7 Bl	198 9.8 Pt	*204104*	198 9.6 Hu
195308	RU AQL	WX CYG	199 9.7 Pt	175 12.1 B	198 9.8 Jo
172[13.8 B	200812	201437b	ST CYG	178 12.6 L	RS CAP
Nov CYG	175 10.0 B	173 11.0 Pt	202954	186 12.5 B	*210116*
195553	183 10.2 Ya	174 10.9 B	173 10.9 Pt	U CAP	158 8.9 By
172[12.2 Pt	186 10.2 B	178 11.3 L	178 11.2 B	*204215*	179 8.8 By
177[12.4 Pt	195 10.6 B	188 10.5 B	183 11.0 Ya	130 11.3 Bl	V CAP
182[13.3 B	W CAP	195 10.4 B	189 11.4 B	139 10.8 Bl	*210124*
196[12.2 Pt	*200822*	U CYG	198 11.6 Hu	149[12.2 Bl	149 12.8 Bl
Z CYG	129 11.5 Bl	201647	199 11.4 B	175 13.6 B	TW CYG
195849	138 11.4 Bl	159 10.7 By	V VUL	199 14.0 B	210129
173 12.5 Pt	148 11.8 Bl	173 10.0 Pt	203226	V DEL	179 10.9 B
174 12.5 B	173 13.0 Pt	174 9.9 B	173 8.5 Pt	204318	190 10.9 B
S TEL	Z AQL	174 11.2 Sp	R MIC	158 8.8 GC	199 11.6 Ie
195855	*200906*	177 9.5 Jo	*203429*	164 9.0 GC	200 11.4 B
145 13.1 Bl	173 13.5 Pt	179 11.1 By	130 10.8 Bl	169 9.3 GC	X CAP
SY AQL	175 13.5 B	180 10.5 Gb	139 10.1 Bl	175 9.5 GC	*210221*
200212	199 11.8 B	183 10.0 Ya	149 8.9 Bl	176 9.6 B	149[12.7 Bl
173 13.2 Pt	R SGE	184 10.2 Jo	Y DEL	181 9.5 GC	X CEP
178 13.5 L	200916	188 9.7 B	203611	188 10.1 B	210382
199 11.8 B	174 9.3 B	195 9.8 B	172 13.5 B	196 10.4 B	155 10.5 GC
S CYG	182 9.5 Ya	198 11.5 Sp	183 13.5 B	198 9.8 Ya	169 11.3 GC
200357	186 9.2 B	198 10.6 Jo	S DEL	199 10.6 B	175 11.4 GC
176[13.2 B	RS CYG	205 10.6 Ya	203816	T AQR	178 11.2 B
R CAP	200938	U MIC	173 11.5 Pt	*204405*	185 11.4 GC
200514	173 7.0 Pt	*202240*	178 10.7 B	173 9.4 Pt	188 11.5 B
173 11.2 Pt	174 7.3 Sp	129 8.0 Bl	188 10.9 B	174 9.1 Sp	195 11.8 B
175 11.0 B	177 7.3 Jo	138 8.3 Bl	195 11.1 B	175 9.0 B	
186 10.1 B	178 7.3 L	149 8.3 Bl		179 8.7 Cl	

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1927.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
Z CAP			S CEP			RV PEG			S LAC			V CAS			R AQR		
210516			213678			220133a			222439			230759			*233815*		
173	11.9	Pt	174	8.5	Pt	174	9.3	Pt	174	9.8	Pt	204	10.3	Hu	179	10.1	Cl
174	12.7	B	177	8.5	Jo	190	12.6	B	180	10.7	L	W PEG			182	9.7	B
183	12.9	B	179	8.8	B	RZ PEG			188	10.8	B	231425			182	9.7	L
R EQU			184	8.6	Jo	*220133b*			195	11.3	B	204	8.9	Hu	Z CAS		
210812			190	9.4	B	174	11.9	Pt	200	12.0	Ie	S PEG			233956		
141	12.4	Bf	204	8.5	Hu	190	9.9	B	R IND			231508			180	[13.5	B
173	13.5	Pt	RU CYG			T PEG			*222867*			174	8.7	Pt	RS AND		
179	13.5	Bf	213753			220412			130	8.2	Bl	204	9.7	Hu	235058		
179	13.0	B	174	8.6	Pt	159	[13.2	GC	139	8.6	Bl	V PHE			158	9.1	By
195	11.3	B	205	8.9	Ya	180	[14.0	L	151	8.6	Bl	*232746*			182	9.0	By
T CEP			RV CYG			Y PEG			T TUC			125	9.7	Sm	182	8.6	GC
210868			213937			220613			*223462*			125	9.6	Ht	RR CAS		
169	7.2	Wk	174	6.3	Pt	166	[14.4	Bf	125	10.8	Sm	126	9.7	En	235053		
174	6.2	Pt	198	7.0	Hu	173	14.9	Bg	125	10.0	Ht	140	9.5	Sm	172	11.3	Bn
177	6.5	Jo	RR PEG			176	14.8	Bf	126	10.2	En	140	9.0	Ht	178	11.2	Ie
178	6.2	B	214024			179	14.7	Bf	131	9.8	Sm	141	8.7	En	180	10.8	B
184	6.6	Jo	174	12.9	Pt	183	14.6	Bg	140	9.3	Sm	146	8.5	En	185	11.2	Bn
188	6.9	B	179	12.6	B	RS PEG			140	9.1	Ht	147	9.3	Ht	195	10.8	B
198	7.6	Ya	195	10.1	B	220714			141	8.7	En	150	9.0	Sm	V CET		
RR AQR			R GRU			166	[14.4	Bf	146	8.5	En	151	9.5	Ht	*235209*		
210003			*214247*			173	14.3	Bg	147	8.7	Ht	153	8.7	En	150	[12.8	Bl
174	10.3	Pt	125	11.3	Ht	176	14.7	Bf	149	8.7	Sm	Z AND			R TUC		
175	10.8	B	126	10.9	En	179	14.3	Bf	151	8.3	Ht	232848			*235265*		
186	11.7	B	130	11.3	Bl	183	14.1	Bg	154	8.4	Sm	174	9.6	Pt	125	9.6	Sm
195	12.1	B	131	11.4	Sm	X AQR			R LAC			ST AND			126	9.1	En
205	[11.4	Ya	139	11.8	Bl	*221321*			223841			233335			131	9.4	Sm
X PEG			140	12.0	Ht	127	11.0	Bf	177	[13.6	GC	169	9.3	Wk	140	9.1	Sm
211614			140	11.6	Sm	166	8.2	Bf	180	[14.0	L	174	9.4	Pt	141	9.0	En
174	9.1	Pt	141	12.0	En	173	8.2	Bg	S AQR			176	9.9	B	147	8.8	En
T CAP			143	12.4	En	176	8.3	Bf	*225120*			184	9.5	Al	150	9.3	Sm
211615			146	12.4	En	179	8.5	Bf	180	[13.5	B	200	9.0	Hu	R CAS		
149	[12.7	Bl	147	12.3	Ht	183	8.4	Bg	RW PEG			R AQR			235350		
175	12.5	B	149	12.4	Sm	T GRU			225914			*233815*			171	7.5	B
197	11.5	B	150	12.1	Bl	*221038*			127	13.0	Bf	125	8.9	Ht	177	7.5	Jo
S MIC			151	12.3	Ht	126	9.5	En	173	14.4	Bg	126	8.7	En	184	7.7	Jo
212030			154	11.9	Sm	131	8.7	Sm	174	14.0	Pt	130	8.7	Bl	Z PEG		
140	[12.4	Sm	V PEG			140	8.6	Sm	179	14.4	Bf	139	8.8	Bl	235525		
150	[13.4	Bl	215605			142	8.6	En	199	12.0	Cl	140	9.2	Ht	174	10.0	Pt
Y CAP			174	9.7	Pt	147	8.2	En	R PEG			141	9.1	En	200	11.3	Ie
212814			179	10.0	B	149	8.8	Sm	230110			142	9.0	Sm	Y CAS		
150	[12.9	Bl	U AQR			154	8.7	Sm	174	11.7	Pt	147	9.2	En	235855		
174	13.0	Pt	*215717*			S GRU			199	12.3	Cl	147	9.4	Ht	180	10.3	B
175	[13.4	B	174	11.2	Pt	*221048*			200	12.0	Ie	149	9.2	Sm	195	10.3	B
195	[13.3	B	175	11.8	B	126	13.0	En	V CAS			150	9.3	Bl	SV AND		
W CYG			180	11.6	GC	140	[12.8	Ht	230759			151	9.6	Ht	235939		
213244			189	11.4	B	147	[12.8	Sm	174	8.7	Pt	154	9.2	Sm	174	9.1	Pt
161	5.9	L	RT PEG			149	[12.8	Sm	177	8.8	Jo	156	9.4	GC	179	9.5	Ie
178	6.4	L	215934			151	[12.8	Ht	189	9.5	B	169	9.3	GC	180	9.2	B
182	6.2	L	179	12.5	B	154	[12.8	Sm	200	10.2	B	174	9.4	GC	200	9.0	Hu
												174	9.9	Pt			

RAPIDLY VARYING IRREGULAR VACIABLES.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
005840 RX ANDROMEDAE—													
	5172.7	13.0	Pt	5176.8	[12.4	Pt		5181.7	11.3	Pt	5196.7	11.4	Pt
	5173.7	13.5	Pt	5177.7	13.3	Pt		5182.7	11.5	Pt	5197.7	11.5	Pt
	5174.7	13.2	Pt	5178.7	[12.4	Pt		5186.7	[11.5	Pt	5198.7	11.9	Pt
	5174.7	[12.4	Pt	5179.7	13.1	Pt		5189.7	[12.4	Pt	5199.8	12.4	Pt
				5180.7	11.5	Pt		5191.9	[11.5	Pt			

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1927.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
060547 SS AURIGAE—				
	5130.5	14.5 Bf	5182.7	14.5 L
	5157.6	14.0 L	5183.3	14.0 L
	5161.3	12.4 L	5183.6	12.5 Cl
	5167.3	12.0 L	5184.6	13.3 Ie
	5171.9	11.4 Pt	5185.6	14.5 L
	5172.7	11.7 Pt	5188.7	13.3 B
	5173.7	11.8 Pt	5189.7	11.5 Pt
	5174.7	12.3 Pt	5190.8	12.4 Pt
	5175.7	12.4 Pt	5191.9	12.6 Pt
	5176.8	12.6 Pt	5196.7	12.4 Pt
	5179.4	14.0 L	5197.7	12.6 Pt
	5179.7	12.6 Pt	5198.6	12.5 Cl
	5180.4	14.0 L	5198.7	12.4 Pt
	5181.3	14.0 L	5199.6	13.5 B
074922 U GEMINORUM—				
	5130.5	13.3 Bf	5181.8	12.4 Pt
	5152.5	11.7 Bf	5182.6	14.0 L
	5157.6	14.2 L	5184.7	12.4 Pt
	5171.9	10.1 Pt	5185.6	14.0 L
	5176.8	12.4 Pt	5190.8	9.3 Pt
	5180.8	12.4 Pt	5191.9	9.4 Pt
213843 SS CYGNI—				
	5157.3	11.1 Be	5161.3	11.3 L
	5157.3	11.1 L	5163.5	10.8 By
	5157.6	11.7 L	5163.6	10.6 GC
	5158.6	11.9 By	5164.5	9.5 GC
	5159.5	11.9 By	5165.6	8.6 GC
	5160.3	11.2 L	5167.3	8.8 L
	5160.6	11.2 By	5167.3	8.8 Be
	5161.3	11.2 Be	5168.3	8.9 L
213843 SS CYGNI—				
	5168.5	9.4 GC	5184.7	11.9 Pt
	5169.4	9.4 Wj	5185.2	11.5 L
	5169.6	9.4 GC	5186.7	11.8 Pt
	5169.7	9.4 Pt	5187.6	11.9 B
	5172.7	10.2 Pt	5188.7	11.9 B
	5173.7	10.9 Pt	5189.5	11.7 Cl
	5174.7	11.6 Pt	5189.6	11.9 B
	5174.7	11.5 B	5189.7	11.6 Pt
	5175.7	11.7 Pt	5190.6	11.9 B
	5176.6	11.7 B	5190.8	11.8 Pt
	5176.8	11.5 Pt	5193.6	11.7 B
	5177.5	12.0 GC	5195.6	11.7 B
	5178.3	11.3 L	5196.6	11.9 B
	5178.6	11.5 B	5197.7	11.5 Kz
	5178.7	11.8 Pt	5197.7	11.6 Eb
	5179.3	12.0 Be	5197.7	11.6 Pt
	5179.3	12.0 L	5198.5	11.0 Ya
	5179.5	11.0 Cl	5198.5	10.4 Cl
	5179.6	11.7 Ie	5198.6	11.0 Hu
	5179.6	11.7 By	5198.7	11.6 Pt
	5179.7	11.5 B	5199.5	8.7 Cl
	5180.4	12.0 L	5199.5	9.0 Ie
	5180.7	11.8 Pt	5199.6	8.8 B
	5180.7	11.6 B	5199.7	9.4 Pt
	5181.6	11.9 B	5200.5	8.7 Ie
	5181.7	11.8 Pt	5200.6	8.7 Lb
	5182.2	11.5 L	5200.6	8.7 B
	5182.7	11.8 Pt	5200.6	8.7 Pr
	5183.3	11.9 L	5200.6	8.7 Cl
	5183.6	11.9 B	5204.5	8.5 Lb
	5184.6	11.9 Ie	5205.5	9.2 Ya

MONTHLY SUMMARY.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Allen	Al	4	4	Iedema	Ie	28	30
Baldwin	Bl	95	191	Jones	Jo	31	58
Bappu	Bf	22	40	Kelly	Ky	2	3
Barry	By	13	28	Kurtz	Kz	16	16
Bashkaran	Bg	7	10	Lacchini	L	52	108
Barnes	Bx	6	7	Logan	Lg	1	2
Benini	Be	4	12	Lubrano	Lb	1	2
Bouton	B	131	256	Peltier	Pt	198	364
Brown	Bn	2	4	Prentice	Pr	1	1
Bush	Bu	2	5	Rittenberg	Rt	18	25
Cherrington	Cb	5	5	Rowley	Rw	3	4
Clement	Cl	8	13	Smith	Sm	46	115
Ebert	Eb	16	16	Soberanes	Sb	4	4
Ensor	En	40	117	Spears	Sp	14	48
Fisher, Thos.	Fs	4	6	Watkins	Wk	9	9
Ford	Fd	12	46	Williams, R.	Wm	4	10
Gaebler	Gb	7	10	Williams, F.L.	Wj	1	1
Hama	H	2	12	Yalden	Ya	20	24
Holmes	Ho	2	4	Georgetown	GC	17	44
Houghton	Ht	32	106	Coll. Obs.	—		
Hunter	Hu	24	24	Totals	40	379	1785

on twenty stars each month are far more desirable than an equal number on four or five variables. This applies to the ordinary long period variable, and not to the irregulars, which should be observed at frequent opportunities.

LEON CAMPBELL, Recorder.

December 6, 1927.

METEOR NOTES.

By CHARLES P. OLIVIER.

During the month of November a good amount of observing was reported by several of our members. Also two sets of observations for October have been recently received. One made by Mr. Ronald McIntosh of Auckland, New Zealand, refers to the Orionids. Despite clouds he was able to observe for short intervals on October 19 and 20, and his maps show an excellent Orionid radiant for October 19 at $\alpha = 91^\circ.1$, $\delta = +15^\circ.3$, based upon 4 meteors, and a fair one for October 20 at $\alpha = 90^\circ.7$, $\delta = +15^\circ.2$, based upon 3 meteors. He writes that due to the low altitude of the radiant, the meteors had long paths, left good trains, and were easy to observe. Of these 7 Orionids, 6 were of magnitude 1 or brighter.

Mr. F. J. Carr of Swanton, Vt., observed on October 25 from 12:10 to 15:00, seeing 26 meteors and plotting 19, the sky being very clear. Not more than 4 of the 19 could possibly be Orionids, but a couple of other radiants farther west are shown. This would indicate that the activity of the Orionids had considerably decreased by this date.

Mr. Vincent Anyzesky of New Haven, Conn., sent in his first contributions. He observed on October 26, November 19 and 25, plotting 42 meteors. All observations were made between 8^h and 10^h, and therefore the last two nights cover the Andromedes. An inspection of the maps shows only 2 or 3 meteors on November 19 and 2 on November 26 that could possibly be from this stream. Indeed since 1899 this stream seems practically to have disappeared. Several minor radiants are shown, the most certain being on November 19, $\alpha = 50^\circ$, $\delta = +36^\circ$, based upon 4-5 meteors.

Mr. James H. Logan of Dallas, Texas, reported 11 meteors casually seen, most being bright objects. He had previously sent in a large number of observations on the Perseids, and isolated interesting meteors, that as yet have not been reported on in these Notes. In the reports of ships, received from the Hydrographic Office and Weather Bureau, a number of very brilliant fireballs were noted, particularly on November 2 to 4. Duplicate observations on any of these objects would be of great value.

At Fort Worth, Texas, Mr. Sterling Bunch and Mr. O. E. Monnig have observed frequently, often together, securing valuable results. The former observed on November 10, 12, 14, 15, 17, and 26; the latter on November 12, 14, 20, and 26. The maximum of the Leonids was covered, as well as of the Andromedes. One possible Leonid on November 12 and one on November 20 were seen by Mr. Monnig, and not more than 2 possible Andromedes on November 20. On November 26 he observed rather too late to see these latter meteors and besides was looking to the east. None of the 31 meteors plotted by him on that night seem therefore to have come from that stream. Mr. Bunch on November 12 saw

one meteor of magnitude 0 that was probably a Leonid. On November 14 from 9:19 to 11:02, out of 14 meteors, no Leonid was seen. On November 15, from 15:35 to 16:05, one Leonid was seen. On November 17, from 10:15 to 15:40, with a clear sky, 50 meteors were recorded. Of these 7 were certainly and 4 probably Leonids. All 11 were of magnitude 1 to 3. On November 26 from 11:17 to 15:00, out of 36 meteors, 2 came from the general neighborhood of the Leonid radiant, but this date is certainly too late for these meteors. Among the large numbers recorded by this observer on November 17 and 26, a few meteors if projected back far enough would cut near the probable radiant of the Andromedes, but many of these seem to belong to other radiants, and in general do not appear to have the characteristics expected. So the Texas observations confirm the non-appearance of the Andromedes in 1927.

The annual report of the A.M.S. for 1927 will not appear before the February number of POPULAR ASTRONOMY. This delay is necessary to permit December reports to be included. All those members of the A.A.V.S.O., who so kindly assist us in the matter, also are asked to send in before January 15 the annual report of the telescopic meteors noted by them. We can confidently predict, however, that so far as the A.M.S. work is concerned the year 1927 will show an immense advance over recent years both in numbers of observations and general accuracy of the work, as well as more intelligent planning on the part of our observers. At least one new field for investigation has been opened up, by two of our observers working together and often recording independently the same meteors. In fact a large part of the credit for 1927 is due to our Texas observers who recently have been doing most commendable work, which is steadily growing in both volume and excellence.

Leander McCormick Observatory, University of Virginia, 1927 Dec. 19.

Flocks of Fire Balls.—*(That celestial phenomena are no longer the concern of the professional astronomer exclusively is evidenced by the fact that the question of meteor observing was deemed of sufficient interest and importance by the editor of the New York Herald-Tribune to entitle it to the editorial comment which follows, in the issue for December 3, 1927.* ED.)

To Dr. Willard J. Fisher, of Harvard, goes credit for popularizing a new game among New Englanders, the game of hunt the fire ball. Last August some one reported in local newspapers sight of one of these large meteors, lasting long enough to make a streak of fire across most of the sky. A published note by Dr. Fisher asking for more information brought 249 replies from persons who thought they had seen this same fire ball. The truth, however, was even more interesting. A study of these reports convinced Dr. Fisher that what his informants had seen was really a flock of these celestial visitors, not one of them. This week's announcement from Harvard records a similar instance. Meteors seen on October 16 are disclosed by similar public reports to have consisted of at least twelve separate objects, all of which must have been traveling through space in a more or less close-packed group and all of which encountered the earth and burned up in its atmosphere at approximately the same instant.

It is not impossible that these observations introduce a new concept in astronomy, the concept of what might be called minor comets. Single meteors are already well known and are believed to be tiny bits of iron or stone, probably no larger than a small nut, which hit the atmosphere, burn up and form "shooting

stars." Comets are believed to consist of somewhat similar materials, but with the particles gathered together in flocks to make the comet's "head," or nucleus. It is probable that some of the particles in these cometary heads are much larger than those that form ordinary shooting stars. The flocks of fire balls which Dr. Fisher's observations disclose may be intermediate between the single meteors and the groups of meteoric particles numerous enough to be visible as comets. Since observation from any single station on earth would not be likely to disclose these objcts as being grouped, they may be far commoner than astronomers have believed.

There is a probability, therefore, that the simple device of using the newspapers to collect observations from many persons over a wide area has led Dr. Fisher to an important astronomical discovery. Perhaps a still greater benefit is that to the public itself. No one really knows a game until he has played it. If the public gets the habit of playing the games of science, that will go farther in making science understood than all the universities and books and scientific magazines combined.

The Polvadera Meteorite. — Our location is at Cornfields, Arizona, 206 miles from Phoenix, in a direction 42 degrees east of north.

My wife and I were sitting in our east room, without a light, between 7 and 8 o'clock in the evening of January 25, 1927, when a bright meteor flashed through the sky. When first seen it was a full blaze, about 30 degrees above the horizon, the roof of our front porch obscuring it from view when it was higher in the sky. It was then about 20 degrees south of east and it disappeared in a cloud, slanting rapidly toward the south, 24 degrees south of east from our position, by the compass, without accounting for the variation of the needle.

When first seen, the streak it was leaving was about the size of an inch rope, as it appeared here. When it got about 20 degrees above the horizon it blazed brighter. At about 10 degrees above the horizon it looked as if it had exploded, flashing out a brilliant, reddish purple light that illumed the whole sky and made it as light as day in our room. At that moment pieces flew out from it in various directions, one large fragment appearing to be thrown off almost straight west from the main mass, as several different colored lights were exhibited for an instant, some having somewhat the appearance of calcium, sodium, and potassium flames. The blazing out flash looked as large across as the width of the full moon appears to be. From that on till the stream disappeared beneath the horizon behind a cloud it rapidly diminished toward the vanishing point. It was probably all of five seconds after I first saw it till it disappeared.

A fragment of this meteor, the one that was thrown off almost straight westward, is reported to have been found in a graveyard at Polvadera, on the Rio Grande, north of Socorro, New Mexico, 200 miles from Confields, Arizona. The remainder seems to have fallen much farther to the southeastward and is known as "the New Aerolite from San Antonio, Texas (?)."

So bright was the sky illumed that many people in western and middle Arizona believed that it fell in the mountains east of Phoenix. To ascertain the location of its falling the Lowell Observatory people at Flagstaff, Arizona, had a notice put in the Arizona (Phoenix) Gazette, asking people to write them about where they thought it fell. Had it fallen in daylight a train of smoke (and dust?), no doubt, would have been left by it through the blue.

This meteor recalls another that the writer saw in May, 1890. He was work-

ing in a gravel pit at Maxwell, near Des Moines, Iowa, when his attention was drawn to a streak of red which dashed from 15 degrees west of the zenith toward the northeast, like a great streak of lightning out of a clear sky, for there was not a cloud in sight. He called other workers' attention to it, all concluding that it lit six or eight miles about north of us—when the papers the next day gave an account of its falling 400 miles distant, in northern Minnesota. Some of the papers also stated that it exploded just before reaching the ground and that the concussion caused by it broke out all the window panes in the vicinity where it fell.

This meteor left a trail of smoke (and dust?) behind it which drifted about in the sky all the rest of the afternoon, not having settled at dark that night. This streak of smoke first appeared as a straight line along the line that the meteor had fallen, then became wavy, showing different currents of air acting on it.

ALBERT B. REAGAN, PH.D.

COMET NOTES.

By G. VAN BIESBROECK.

COMET 1927 *k* (SKJELLERUP).

The last month of the year has been marked by the unexpected appearance of a very bright comet. The first information came in the form of a telegram from Melbourne, dated December 3, saying that a third magnitude comet had been discovered there by Skjellerup, in the position:

Dec. 3.7292 U.T. $16^h\ 12^m\ 12^s$ $-53°\ 57'$

The comet showed a tail 3° long and seemed to move towards the sun.

The name of the amateur astronomer Skjellerup has been connected prominently with recent cometary discoveries in the southern hemisphere; from South Africa he has now moved to Australia and his enthusiasm for comet-searching has again been rewarded.

The next information about the comet came from La Plata, and gave the position:

Dec. 6.025 $16^h\ 27^m$ $-50°\ 0'$ 2M

One more position from Santiago (Chile):

Dec. 7.8586 $16^h\ 41^m\ 17^s$ $-47°\ 48'\ 10''$

confirmed the north-easterly motion.

The new object soon moved in towards the sun so that accurate positions could no longer be obtained. At the same time it increased so much in brightness that on December 16 it was reported as visible in full daylight with the naked eye, from the La Plata and the Lowell (Flagstaff) Observatories. At the latter station the comet was reported as being many times brighter than Venus, and conspicuous to the naked eye, although only five degrees from the sun.

The brightness was such that spectrographic and radiometric measures were secured in full daylight, but on the following days the comet faded rapidly with "marked changes in the appearance in the spectrum and in the radiometric quality."

In the meantime, orbits had been computed from observations in the southern hemisphere. The first computation by Wood (Johannesburg) gave December 1 for the perihelion passage, and raised high anticipations of visibility for the

northern hemisphere in the latter part of December. A rough position by Burton at Washington:

Dec. 17.923 $17^h\,47^m$ —15° 19′ Magnitude —2 "Faint tail"

showed that the comet had not moved as far north as predicted.

A second computation by Dawson (La Plata) placed the perihelion on December 18, and showed that the comet would move north a little beyond the equator, in which case the visibility, although less favorable, would have been quite satisfactory in northern latitudes. But even this prediction proved to be too favorable. For several days following, the comet stayed nearly in conjunction with the sun, its declination not reaching farther north than —11° on December 21.

At the Yerkes Observatory cloudy weather prevented observations until the evening of December 18, when the comet was seen with the naked eye by various observers in the rough position:

Dec. 18.954 $17^h\,44^m$ —13° 25′

which is only 10° from the sun.

It showed a bright nucleus with a paraboloid envelope curving back so as to form a tail opposite to the direction of the sun, and visible in a 4-inch finder, over some 20′ on the bright evening sky.

The next morning it was followed with the 40-inch telescope. The brightness was still sufficient for making it fairly easy to see in daylight. Haze coming up after 10:00 A.M. prevented us from following the nucleus through the day.

No stars being visible in the field of the comet, the usual way of measuring, consisting of referring the comet to neighboring stars, could not be used. With the 40-inch telescope a large number of circle readings were made by Mr. W. Morgan and the writer, and these were corrected for refraction and for instrumental errors by checking on known stars, observed before or after on dark sky in the same position of the telescope. Thus the following positions were found here:

U. T.	h m s	° ′
Dec. 19.5631	17 45 11	—12 40.7
20.5512	46 58	11 42.2
20.9492	47 41	11 27.7
21.5474	48 43	11 19.3
22.5594	50 24	11 23.3
Dec. 23.5549	17 51 57	—11 31.7

They show that the declination did not go north of —11°, and that the apparent course turns back to the southern direction, from which the comet had come. On December 22 the comet was seen with difficulty with the naked eye, about half an hour before sunrise. The next morning it could not be seen any more with certainty without instruments. In the telescope the brightness was then estimated as equivalent to that of a 2^M star, but that figure is quite uncertain on account of the unusual conditions of visibility. Plate A (frontispiece) shows the appearance of the head on the morning of December 23. The peculiar dissymmetrical appearance of the envelope was quite striking. This rough drawing was made by the writer because it was not possible to photograph the object with ordinary photographic means on the brightly illuminated sky. However, Professor F. E. Ross succeeded in securing some small scale images by the use of a 3-inch lens of his design in connection with plates sensitive to the infra-red rays. They show the tail extending to about 1° from the nucleus on December 22.

The conditions of visibility will remain extremely unfavorable for northern observers, the comet going south as it moves out of the vicinity of the sun.

No satisfactory elements have been received at the time of going to press (December 28).

The other comets now under observation are all faint.

In the evening sky, PERIODIC COMET 1927 *h* (ENCKE) is brightening up as expected. On December 21, it was seen as a large nebulous object in which a little nucleus had made its appearance, but the total light is not more than 12M, and it will soon be difficult to see in the western sky.

COMET 1927 *j* (SCHWASSMANN-WACHMANN) is by far the faintest one now under observation. The writer found much difficulty in locating it on some of the photographs taken with the two-foot reflector; variability in brightness seems the only way of explaining this circumstance.

On December 14 the total brightness was estimated visually as 14M with the 40-inch refractor, while on December 21 it was extremely faint at about 16M. On November 26 the photographic impression was estimated as 14M, but on December 1 good plates show it as hardly of 16M. This is quite unexpected in an object which is evidently very far away.

From observations covering the interval November 15 to December 15, L. Berman and F. L. Whipple at Berkeley, California, have deduced the following elements:

$$\left.\begin{aligned} T &= 1926\ \text{Oct.}\ 16.123\ \text{U.T.} \\ \omega &= 43^\circ\ 28'\ 5''.6 \\ \Omega &= 321\ \ 53\ \ 0.9 \\ i &= 9\ \ 22\ \ 59.4 \end{aligned}\right\} 1927.0$$

$$e = 0.078681$$

$$\text{Log. } a = 0.810074$$

$$P = 16.41 \text{ years}$$

giving the ephemeris:

0^h U.T.	α (1927.0)	δ (1927.0)	Log. Δ	Log. r
	h m s	° ′ ″		
1927 Dec. 14	1 25 28.63	+19 47 27.6	0.7309	0.7787
22	25 5.68	34 3.7	.7398	.7788
30	25 26.75	24 17.3	.7492	.7788
1928 Jan. 7	26 31.17	18 27.6	.7588	.7792
15	28 17.06	16 39.4	.7685	.7793
23	30 42.27	18 52.5	.7781	.7795
31	1 33 44.28	+19 25 3.0	0.7874	0.7796

Although eccentricity and perihelion are qualified as "unreliable" it appears that it is another periodic comet with an unusually small eccentricity, making the orbit nearly circular with a radius of six astronomical units and therefore situated outside of Jupiter's orbit. If this result is confirmed the comet occupies an unique position and would come under observation about every thirteen months, very much like an asteroid.

In the morning sky COMET 1927 *d* (STEARNS) comes now again in good observing conditions. It follows closely the ephemeris given on p. 474 (Vol. XXXV), the continuation of which is as follows (*Circ. Copenhagen*, No. 169):

	h m s	° ′
1927 Dec. 25	16 19 46	+31 38.4
1928 Jan. 2	29 4	33 2.4
10	38 10	34 35.1
Jan. 18	16 46 51	+36 16.0

On December 21 I estimated the brightness as 13M.

COMET 1927 *g* (SCHAUMASSE) is also still under observation, but quite faint in the morning sky, near the ephemeris position (p. 526, Vol. XXXV).

I have tried here to record again COMET 1926 *f* (COMAS SOLÁ) by photography (Dec. 21) but have not yet succeeded. It is still somewhat too low in the morning sky and evidently quite faint.

Williams Bay, Wisconsin, December 24, 1927.

GENERAL NOTES.

Greeting.—*Science,* being concerned primarily with relentless facts, is commonly thought of as cold and entirely devoid of sentiment. Be that as it may, it is nevertheless true that *scientists* are human beings and as such share the feelings of a kinship and a fellowship of a common humanity. It is on this level, therefore, that, at the beginning of a new year, the management of POPULAR ASTRONOMY extends to the readers of POPULAR ASTRONOMY its heartiest good wishes, and its hopes for a year of health, happiness, and prosperity. Towards the realization of these hopes, POPULAR ASTRONOMY will contribute to the utmost of its possibilities. Health of the mind, as well as of the body, is highly important; we shall endeavor to furnish wholesome mental sustenance. To those for whom the oldest of the sciences holds a peculiar charm, our pages should bring a degree of happiness. And if at the end of the year one finds also that his fund of interesting information has been augmented, would it not be true that he has to that extent prospered?

Professor Henry Norris Russell, of Princeton University, lectured on December 9 at Smith College on "What are the Gaseous Nebulae?" (*Science,* December 16, 1927.)

Professor H. N. Russell, of Princeton University, gave a talk at the U. S. Bureau of Standards on November 4. on "The Structure of the Elements of the Iron Group." On October 15, J. W. French, technical director of Barr and Stroud, Ltd., manufacturers of military optical instruments, Glasgow, lectured on "Optical Glass" at the bureau. (*Science,* December 2, 1927.)

Professor Albert A. Michelson, head of the department of physics at the University of Chicago, has returned from Pasadena, California, where he had been attempting a repetition of his experiment on the speed of light. Professor Michelson attempted to send a beam of light on a round trip of 164 miles, but was unable to do so because of haze and unsatisfactory weather conditions at the Mt. Wilson Observatory. (*Science,* November 25, 1927.)

Dr. Walter S. Adams, director of the Mount Wilson Observatory, delivered an address in the assembly room of the administration building of the Carnegie Institution of Washington on Tuesday, December 6, 1927, on the subject "The Interior of a Star and How it Maintains its Life." Dr. Adams pointed out that "a star like our sun is a great engine which is pouring energy into space at an enormous rate. Even at the distance of the earth this is nearly five million horse-power on each square mile of surface. Many of the stars give out much more light and heat than our sun. The application of our present knowledge of

the atom and the structure of matter gives us a conception of the interior of stars, the source of the supply of energy, and the time-scale on which stellar processes operate."

Mrs. Sherburne Wesley Burnham (née Mary Cleland) passed away, in her 84th year, on October 14, 1927, at her residence in Chicago. She was ill but a short time. Three sons, three daughters, and nine grandchildren survive her. Her distinguished husband died in 1921. Her utmost devotion was always given to her husband and family, and their hospitable home was a rendezvous for American and foreign astronomers when passing through Chicago.

Amateur Astronomers' Association.

Headquarters: THE AMERICAN MUSEUM OF NATURAL HISTORY
77th Street and Central Park West
New York City.

Information about the newly formed Astronomical Society.

Name:	Amateur Astronomers' Association.	
Object:	To promote the study of Astronomy by non-technical methods and to emphasize the cultural and inspirational value of this subject.	
Membership:	Regular	$ 2.00 per year.
	Supporting	5.00 " "
	Contributing	10.00 " "
	Life	25.00 paid at one time.
	Patrons	100.00 or more paid at one time.
	Benefactors	500.00 " " " " " "
	Honorary	No dues.
Officers:	Dr. Clyde Fisher,	President.
	Mr. Stansbury Hagar,	First Vice-President.
	Mr. George A. Galliver,	Second Vice-President.
	Mr. Fairfax Naulty,	Third Vice-President.
	Dr. Oswald Schlockow,	Fourth Vice-President.
	Miss M. Louise Ricker,	Secretary.
	Mr. Harry Lawton,	Treasurer.
Meetings:	To be held at the American Museum of Natural History, 77th Street and Central Park West, on the first and third Thursday evenings of each month, EXCEPT July and August. Meetings will commence PROMPTLY at 8:15 P.M.	
Affiliation:	Amateur Astronomical Societies of other cities may become affiliated with this Association, upon application.	

Zodiacal Light Observations.— As the time of year is approaching when the zodiacal light is best seen in the western evening sky after the disappearance of twilight, may I again call attention to this interesting phenomenon associated with the names of Jones, Heis, Searle, and Barnard? No one can see the zodiacal light for the first time without being thrilled by its singular beauty. A general idea of the zodiacal light can be obtained from almost any standard textbook. Observations can easily be made by a person of keen sight, no apparatus being necessary. It is desirable to have many observers. It is essential that all observers should follow the same system of observation, a system which gives attention to the boundaries of the light, its elongation from the sun, any changes in its intensity, the condition of the atmosphere, and exact date and time of observation, all of which data should be carefully recorded the same evening together with name of place of observation. A diagram of each observation show-

ing the starry background of the heavens against which the zodiacal light is seen would be of added interest. More than one observer at each station would be advantageous provided that each observer is conscientiously independent in his or her observations. But we also need many stations with the observations as nearly contemporaneous as possible.

The editor of POPULAR ASTRONOMY has offered to publish reports of such observations. In order that the results may be organized into a systematic plan, observers are requested to send the data of their observations to the undersigned as promptly as possible. He will formulate them and forward them so that they may be published without too great a delay. Only by some such means of direction and coöperation can real progress be made in the investigation of zodiacal light phenomena.

W. E. GLANVILLE.

The Rectory, New Market, Md., 1827 Dec. 14.

The International Congress of Physics.— During the week commencing on September 11, a meeting of exceptional interest was held at Como in Italy, in commemoration of the first centenary of the death of Volta. It is probable that no previous congress has ever brought together so representative a gathering of physicists, for, with very few exceptions, the leading authorities in all branches of the subject attended the meeting and gave short addresses on developments in their own fields. Fourteen countries were represented by about sixty guests who were invited to attend the congress; these included amongst their number eleven Nobel laureates. The meeting will surely be remembered as a historical one.

The program was divided into five general sections, one for every day:

(1) Researches into the structure of matter.
(2) Electricity and its applications.
(3) Electrical theory.
(4) Physical optics.
(5) Theories of the structure of matter and of radiation.

On the sixth day, in the lecture-room of Volta at the University of Pavia, a résumé of the work which had been accomplished and of the problems discussed was presented by Prof. Lorentz representing the theoretical physicists and by Prof. Majorana representing the experimental physicists.

The scientific meetings at Como were followed by a visit to Rome. The members of the Congress were received by the Italian Premier, Signor Mussolini, who expressed his appreciation of the work which had been accomplished. Senator Marconi, who delivered an address in the Capitol on Volta's life and work, expressed the feelings of all who attended the conference when he congratulated the president, Prof. Majorana, and secretary of the Congress, Prof. Pontremoli, on the way in which the meeting was organized and conducted. (*Nature*, October 8, 1927.)

Heat of the Sun.—I have no doubt what I am about to write will meet with skepticism and be considered as a vagary of an untrained mind. Be it so, I have the satisfaction to know that the scientific world is no nearer a solution of the sun's heat, than a guess.

I think there is sufficient merit in the theory I herewith advance, to at least bespeak some consideration of scholars who are deep in sidereal lore.

I am aware that mankind is slow to accept the unusual and does not take

kindly to new ideas unless promulgated by well known authority. Many writers are prone to cling to popular authorities for a long time without question. Scientists have many times found it necessary to revise accepted formulas. Many theories have been advanced to account for the heat of the sun. This little article may call forth discussion leading to a correct solution of this unsettled question. It is not surprising that one feeling the warmth of the sun's rays should look upon it as a heated body. If so, we must consider that this heat must be radiated through a space of 93,000,000 miles; we wonder how it is possible for any substance to endure a heat so intense that we can feel its influence so far away and itself not be dissipated. C. A. Young asks, "How is such a heat maintained? How long has it lasted already? How long will it continue? Are there any signs of either increase or diminution—questions to which, in the present state of science, only somewhat vague and unsatisfactory replies are possible." Forest Ray Moulton, I believe quoting Mr. Young, says, "Many different theories have been proposed, two of which now chiefly occupy the field. One of them finds the chief source of solar heat in the impact of meteoric matter, the other, in the slow contraction of the sun. The temperature is far beyond that required to melt or vaporize any known terrestrial substance. Many methods have been used for obtaining the temperature of the sun, but most of them have rested on physical principles, which are unsound." One writer suggests that the sun is of or contains a large proportion of radium. With all the theories, they so far do not try to get away from the idea of radiation from a hot body. The sun's rays are different from any heat or light rays, produced by combustion of any substance on earth—more diffusive. I notice that after discarding the idea of a superheated sun, they fall back on the compression theory to explain the wonderful warming power of this great luminary and cling to the thought of direct heat radiation. The experimenter in the use of his intricate apparatus, for measuring solar heat, does not take into consideration the combined effect of light and air. which might be quite different were it possible to measure the heat above the air.

The effect of the light ray on the atmosphere must surely lead one astray as to the ray *per se*. He is simply measuring the combined action of light and air. The nearer we approach a heated body on earth, the more we feel the heat; on the contrary the nearer we approach the sun the cooler we find the atmosphere, as evidenced by the aviator's experience as he ascends, and the perpetual snow on the highest mountains. This should cause us to wonder if the sun is really hot. Then arises the question: If the sun is not hot, what then is the explanation of the heat we receive from that source?

Perhaps there is a satisfactory answer to this world-age question, one that will clear up this much mooted phenomenon. We are told that everything is in a sort of vibration, nothing stands absolutely still. Our brain receives knowledge of the world through vibrations impinging on our organs of sense. All life and growth is the result of vibration and circulation. The heat of the sun is no exception to this law.

The sun's rays coming from a distance of 93,000,000 miles, at the astonishing rate of 186,000 miles per second, every atom of atmosphere receives the impact of a tremendous blow, coming with inconceivable rapidity. This onslaught on every atom, or molecule of the atmosphere, causes friction and vibration sufficient, together with an electro-chemical action, to account adequately for all the heat we receive from this great orb of day.

Einstein states that beams of light have mass and weight, and are deflected

from a straight line by gravitation. Hence, if the sun's rays are proven to have weight it is reasonable to assume that their impinging on the atmospheric body would cause sufficient agitation and vibration to account for the heat we receive from the sun. I have no doubt that investigation along this line will prove this theory correct. The sun is not hot, but gives us heat by the action of its rays on the intimate structure of the atmosphere through the vibrations of its electrons.

E. A. CONVERSE, M.D.

2327 N. W. 26th St., Miami, Fla., October 24, 1926.

BOOK REVIEWS.

New Aids in the Teaching of Astronomy.—Two pamphlets have recently been received which are designed to facilitate the teaching of elementary astronomy. The first of these, prepared by Dr. Harlan True Stetson, is entitled "Sky Map Construction for Everybody"; the second, prepared by Dr. John C. Duncan, is especially adapted to the recording of observations. These pamphlets contain suggested problems, data necessary for their solution, list of prominent constellations and conspicuous stars, blank forms to be filled in by the student, a scheme for locating the change in the sunset point, and other features, all of which it would seem, would serve to engender interest on the part of the student and assist him to a better understanding of the subject. They are published by the Eastern Science Supply Co., P. O. Box 1414, Boston, Mass.

Stern-Atlas "Beyer-Graff".—This new star atlas consists of twenty-seven charts and contains all stars to 9.3 mag., as well as the brighter clusters and nebulae, between the North Pole and —23° for 1855.0. The charts, published in manuscript, have been drawn by Max Beyer and edited by Professor K. Graff of the Hamburg Observatory at Bergedorf. They are drawn on a scale of 1 cm = 1° (a 5° net is printed). Each of the first twelve charts covers $2^h\,8^m$ in Right Ascension and 45° in Declination (from —23° to +22°). The next twelve extend from +20° to +60°, and the remaining three from +60° to +90°. With a view of facilitating the identification of faint stars with the catalogues of the Bonner Durchmusterung, the equinox used is that of 1855.0, but conversion to any other is easy as the precession for 100 years is given at six points on each chart. In making the charts it was possible to take the positions of the bright stars directly from the B.D. Catalogues, but for the fainter ones reference to other sources was necessary. Nebulae and clusters were taken chiefly from Holetschek's list and are marked by crosses. A durable quality of paper has been used which stands the erasure of pencil marks well.

The charts will without doubt, be welcomed by all working astronomers, especially amateurs, for whom a moderately priced substitute for the B.D. charts has long been needed.

Part I. Zone —23° to +22° on sheets, each 42 cm x 57 cm, containing some 84,000 stars, 12 sheets with title-page, $3.50 prepaid.

Part II. Zone +20° to +90° on 15 sheets, each 42 cm x 57 cm, containing some 93,000 stars, $4.30 prepaid.

They may be ordered from Max Beyer, Hamburg-Grossborstel, Lockstdterdamm 11.